A Consolidation of Engineering News, Engineering Record and The Contractor

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

McGraw-Hill Publishing Co., Inc.
JAMES H. McGRAW, *President*
E. J. MEHREN, *Vice-President*

FRANK C. WIGHT
Editor

Volume 97 NEW YORK, DECEMBER 23, 1926 Number 26

But Once a Year

TIME is a part of the eternal verities. Its recording is an invention of man, a device to regulate his comings and his goings, a reminder of things to do and of things left undone. Without the ever recurring similar markings on the wheel of time life would be an endless procession of unrelated events. Memory would disappear in nebula and anticipation lose its most engaging attribute.

Each day, each month, each season brings with it memories which become the guideposts to routine and as such help to ease the machinery of living. Christmas might easily fall into that class, to become merely as Monday, a day to start a new week's work, or as summer, a time to cease for a while from working. It might become merely an adjunct to the department store, or if there be children in the house, a time alone of gifts and gaiety.

As such Christmas would be no more than any other of the holidays, except that its season, in preparation, in realization, and in recovery lasted longer. Christmas is more than that. It is a period of spiritual invigoration. Too many of us forget in this most material of existences that we have a spirit. Too often we flinch, as though in fear of doing something not quite manly, before the demands of the spirit.

But Christmas, emphatic in its inevitable recurrence, opens to us all an opportunity to rise above our common repressions, to give and to forgive, to practice good will and to wish for peace with all men. To do that but once a year may seem to be easy—and futile. But it is neither. For to do it rightly and honestly is to overcome the prejudices and nabits which bind us all and to overcome them but once instills a virus that works and works throughout the year.

Conowingo

ELSEWHERE in this issue is given a brief statement of what comprises the hydro-electric development at Conowingo, Md. The amount of power to be developed, the difficulties overcome in getting state and federal authority to start work, and the magnitude of the construction operation which is now well under way, all tend to make the project one of unusual interest. Despite the complications of the interstate features of the project and the restrictions of its own charter, the Philadelphia Electric Co. has been able to get the necessary licenses and set up new corporate organizations to finance and operate the plant. While these legal problems were being solved, the engineering plans and construction program were worked out in detail so that when the license was granted this spring, work started immediately. As a result, it is expected that before two years are up the first unit will be sending power to Philadelphia. Seven units, with a total capacity of 378,000 hp., are to be installed at once, a greater installation than in any hydro-electric plant in the United States except at Niagara. Eventually there will be 594,000 hp. Thus will be built a power plant greater than Muscle Shoals in its immediate capacity and practically equal to it in its ultimate capacity, whose power will be absorbed by the growing industries of the Philadelphia region without the aid of congressional committees or Henry Ford or any self-appointed guardian of the people's welfare. The two projects provide an excellent opportunity for comparing the possibilities of government versus private handling.

Take Warning

WATER-WORKS officials should take warning from the experience of the Detroit Water Board, noted on p. 973 of our issue of Dec. 9, in case of any other attempts of local internal revenue agents to collect an income tax on water-works earnings. The Detroit agent, on advice from Washington that he should collect income tax for 1925 and subsequent years from employees of the municipally owned water-works and street railways, jumped to the conclusion that the income of the local water board—and presumably of the city's street railways also—was subject to tax and demanded payment. The manager of the water-works took the matter up with the Commissioner of Internal Revenue and was advised not only that the Detroit agent was in error but that the Internal Revenue Act of 1926 specifically exempts the earnings of utilities, municipally and state owned. While it is unlikely that many other local collectors will blunder in just this way it is quite possible that some of them will do either this or something equally unwarranted by law. An immediate appeal to Washington headquarters is advisable whenever a local agent departs from well established rules, particularly in cases like the one at Detroit where no attempt has been made heretofore to collect a tax suddenly demanded. With an overflowing treasury such attempts as the one at Detroit might not be expected. However, it is not the condition of the treasury, but the requirements of the law that concerns revenue collectors; all the more need that they do not overstep the law on their own initiative.

High Building Absurdity

ANNOUNCEMENT of a 110-story building in New York City closely follows that of an 80-story one in Detroit. The announcements are circumstantial and the projectors of both buildings responsible, but one is permitted to doubt whether either structure will be carried to such extraordinary heights. And if they are really built so towering the doubt will change to wonder why. The Detroit enterprise is somewhat explainable, for the family contemplating it is wealthy, with a large interest in the real estate immediately surrounding the site and with a pardonable ambition not only to glorify the city that has made it rich but also to commemorate the family name. As a monument the projected Book-Cadillac tower is quite as justified as any philanthropic city memorial. Detroiters, looking at its heaven-kissing peak, will doubtless swell with that queer municipal pride which leads us all to take personal credit for the things that are done in the place where we live. The New York building, on the other hand, is given out as a serious business proposal, with only a minimum of the monumental and the self-laudatory; certainly there is small need of adding to the already sufficient metropolitan boastfulness. But if a 110-story building of the dimensions shown in the sketch in our news pages is an economic proposition, if people can be found who will trade the sensation of housing themselves so high for the manifest discomforts of delay, if economic return can be guaranteed for such an increase of dead-load and wind stress and elevator space—then most of the existing theories of economic building design must go by the board. Structurally, both of these buildings are possible; from most other viewpoints they are absurd.

Cost Records for Contractors

WHETHER highway contractors do or do not keep cost records and use them in preparing bids, in principle they appreciate the value of such records, although it is hard to get away from the old practice of bidding a price based on the desire to get the contract. In a two-day meeting of the Illinois Association of Highway and Municipal Contractors, this was the main subject of papers and discussions. Every speaker admitted the importance or even necessity of such records, but it was also evident from the numerous statements made that as a general thing such records are kept (or used) only to a limited extent; and furthermore, that they are not kept on a uniform basis so as to be comparable. It is worth noting that this association, recognizing the importance of itemized and uniform cost records, has had for the past few years its own field engineer, who has for his main duty the study of construction costs and who has drafted forms for records and estimates, including such often overlooked overhead items as repairs and depreciation. If the strong appreciation of these records and forms as expressed at the meeting is followed by adoption in practice, even to the extent of losing contracts which do not promise a reasonable profit, a greater degree of prosperity may be expected among contractors as a whole. From an illustration given by one speaker, where at a second bidding the original prices were scaled down about 25 per cent because it was announced that contracts would not be awarded above a certain figure, it is evident that too often the price bid is that at which the bidder thinks he can get the contract.

Reinforced Concrete Indicted

SEVERAL pages of this issue are given up to a condensed reproduction of Professor Swain's paper on reinforced concrete and steel, first presented two months ago in the friendly atmosphere of a steel fabricators' convention under the title "Steel for Strength and Security," but repeated last week in open forum, before the Boston Society of Civil Engineers, under the more moderate title, "Why I Prefer Steel to Reinforced Concrete." Probably no more astonishing utterance has been made in the structural field within memory. The paper is a sweeping denunciation of reinforced concrete, ignoring the brilliant achievements of practice, oblivious of the fact that the world is definitely in an age of concrete, and essaying extravagant praise of a rival material which in truth needs no advocate. Under less distinguished authorship the paper would no doubt be resented; but Prof. George F. Swain, for a quarter century chairman of the Boston Transit Commission, Gordon McKay professor of civil engineering at Harvard University, past president of the American Society of Civil Engineers, is entitled to respectful hearing, by steel and concrete men alike.

The original paper is extremely long. In our necessarily brief (but we think fair and representative) reproduction, we have omitted most of the praise of steel which accompanied the condemnation of concrete. Steel needs no praise. Nor—in this age—does concrete require denunciation. And indeed the paper contains nothing new in point of facts presented; the new and radical feature lies in the interpretation put upon these facts, and their attempted use to outlaw reinforced concrete.

It is an unusual task that the veteran educator and engineer engages upon in his paper. His professed aim is to *compare* structural steel with reinforced concrete, and to show that the latter material is "very much over-advertised, over-praised, and over-boomed." He undertakes to do this by setting over against each other the virtues (but not the defects) of steel and the shortcomings (but not the excellences) of concrete. As human nature is constituted, such one-sided reasoning rarely leads to sound conclusions on the part of its author, or to acceptance of the argument on the part of its hearers.

For the same reason of uneven balance, moreover, the paper overreaches itself and is in conflict with the facts of experience. The argument overreaches itself in so far as it urges the existence of inherent defects in concrete that if they were as bad as pictured would make any and all use of the material hazardous and temporary—in road, dam or foundation, no less than in building or bridge. The author himself shrinks from carrying condemnation to this logical extreme, with the result that the reader is left to flounder in doubt as to the truth of all the author's claims.

And at the same time the argument conflicts with experience because during three decades reinforced concrete has won its way to recognition against heavy odds; by no means did it find a royal road to engineering acceptance, nor was it "advertised" or "boomed" into its extensive use. Its solid, practical merits are solely responsible for its progress. In the face of its record, criticism faces the challenge of experience, and denunciation is singularly inappropriate, yes, quixotic, for an attempt by academic argument to rule out of court the

proved service and utility of the material is hardly more hopeful than the famous Don's attack on the windmills.

Nevertheless, the paper will prove of much value, and this is one reason for asking the reader's attention to it. It is a studied indictment of concrete, based on a large accumulation of opinion and observation, not heretofore brought together in this form. We do not refer in this remark to various statements which the author introduces for comparative effect, such as the vague generality that concrete is made (and may be poorly made) on the job, while steel is made (and by implication is perfectly made) in the mill; nor to such dubious claims as that concrete is jeopardized by internal stresses while steel can be annealed and freed from these stresses. What we do mean to include is the recital of facts on slow, long continued set, on the volume changes caused by temperature and moisture, on the way in which poor aggregates, wrong proportioning, amount of water, and segregation may harmfully affect the quality of the concrete, on the frequently occurring and still completely baffling surface disintegration, on frost and alkali effects, and the like. None of these facts are new or unknown, but they are massed in one damning indictment.

Also, the paper serves usefully as a restatement and summing up—though an extreme one—of the skepticism voiced in recent years by some who have been particularly troubled by concrete deterioration, probably in all instances surface deterioration.

It will benefit every engineer to have before him such a new and animated collection of facts and references. For years all effort in the field of concrete has been directed toward better knowledge and practice in these matters—with excellent results—and no doubt for many years further effort will be put upon them. It is through clear recognition of the difficulties in question that so much progress has been made, especially in the last decade. And by the same token further progress depends on keeping them clearly in view. Toward this end, Professor Swain's paper will aid. In the field of concrete we need always to think; and there is some advantage in thinking in the light of a hostile argument.

In order to make the paper most serviceable in this constructive function, it needs to be clarified and commentated by discussion. Some such discussion was offered at the Boston meeting, but under disadvantages; it is not easy to discuss an argument of one-and-a-half-hour's extent with no advance knowledge of its contents. Thus, the remarkable interpretation which the author put upon swelling and shrinkage under moisture change, an interpretation which, if proved, would require that every concrete structure of 10 or 15 years' standing should be in the last stages of decrepitude, deserves to be critically illuminated by contrasting it with the facts of service experience. So, too, his ridiculing of the stress theory of reinforced concrete is worth further remark, as is his use of two dams that went out in the foundation (Gleno and Dolgarrog) to strengthen his claims about percolation. And his charge that fireproofing requirements for steel members and reinforced-concrete members represent "gross discrimination" may well lead to a re-citation of the hard facts of fire exposure tests and experience with destructive conflagrations.

After full discussion, the paper will unquestionably prove definitely helpful and promotional in the further application and development of reinforced concrete. Coming at the close of a time when various points of dissatisfaction with concrete and the practices of concrete construction have been mooted, and many improvements of practice have been made; at a time, too, when a new period of research in both cements and concretes has begun, and when practice is on the threshold of a new era of more uniformly excellent and better known concrete, the paper supplies a review of many doubts and difficulties that have heretofore troubled the engineer, and also brings to mind some that will continue to require thought and study. It will aid rather than injure reinforced concrete, for it will, as the author concludes, make people think.

Why an Engineering Report

THE Corps of Engineers has voiced its opposition to two important waterway projects, the Great Lakes-to-Hudson canal, and the canalization of the Missouri River above Kansas City. It would seem that politically this is a great mistake. What the waterways advocates want is not an engineering report as such, but a *favorable* report by the Corps of Engineers which can be used to urge the assignment of funds to the projects by Congress. And if the Engineers cannot see their way clear to make such a report, the pet projects must go forward anyhow.

Concerning the Missouri River project the Chief of Engineers recommended postponement of the complete project and the construction of certain bank-protection work at present which would become part of the canalization project eventually. He had, however, the temerity to recommend that local interests contribute to the latter work. This, too, apparently was in error. Waterway advocates do not want such recommendations made to Congress any more than they want carefully weighed opinions by a judge who can give it the results of a detailed study of the project such as the members themselves have not the time to make. The Senate committee, in order to keep the Chief of Engineers from repeating his political mistake, has proposed an amendment that "hereafter no recommendations shall be made by the engineers or the Secretary of War for contributions by local communities."

In the case of the Great Lakes-to-Hudson Canal where the weight of evidence was against construction of that canal as compared with improving the St. Lawrence the proponents have had to fall back upon the international features of the question. Judged by statements of Representative Dempsey, chairman of the House Committee on Rivers and Harbors and one of the sponsors of the canal, it is safe to say that when Congress comes to consider the subject it will hear a lot about "entangling alliances" and little about cubic yards of concrete or tons of freight.

Some waterways are needed; many, as General Jadwin says concerning the Missouri River project, are so located that they should not be undertaken until traffic in connecting waterways indicates that they can be safely expected to become paying propositions. Others, like the Lakes-to-Hudson Canal, have no economic justification. How can we expect Congress to act intelligently on the allocation of funds if the careful studies of the Corps of Engineers are not given more consideration by its committees than those now in Washington seem disposed to give?

Construction of Great Water Power Plant Well Under Way

Conowingo Hydro-Electric Project on Susquehanna River to Be Second Only to Niagara in Initial Installation—Dam to Be 4,800 Ft. Long

EARLY this year work was begun on the Conowingo hydro-electric development on the Susquehanna River in Maryland, a project which will utimately have installed generating capacity of 594,000 hp. On account of the magnitude of the undertaking, and the amount of money involved, every effort is being made to make the construction period as short as possible. The license for the project was issued on Feb. 20 of this year, and work was begun on March 8. Despite the inaccessibility of the west end of the dam, the power house end, rapid progress has been made since that time, as indicated in the accompanying photographs which were taken early in October when the power division of the American Society of Civil Engineers visited the project. Nearly 3,000 men were employed on the work at that time. A construction program has been worked out which, it is expected, will make it possible to bring the first unit into operation about the middle of 1928.

FIG. 1—GENERAL VIEW OF THE PROJECT FROM THE WEST BANK OF THE RIVER
Cofferdam for the power house and part of the tail-race in the foreground. That cofferdam has been built high enough to keep out the spring floods in 1927. On the opposite side of the river is the cofferdam for the east end of the dam. This cofferdam has been built with stop-log openings to pass the spring floods.

The possibilities of the Susquehanna River in the neighborhood of Conowingo, Md., as a great source of water power, have been realized for many years, but the obstacles in the way of damming the river at that point were such that the development of power there was an economic impossibility until a market was available for the large amount of power which necessarily must be developed to carry the charges on the investment. Such a market now exists in Philadelphia, and the Philadelphia Electric Co., through subsidiary corporations, is developing the site and will transmit the power to Philadelphia, a distance of 70 miles, at 220,000 volts.

The fact that the power plant is being built in Maryland, that the reservoir above the dam will be in both Maryand and Pennsylvania, that the power which will be developed in Maryland is to be sent into Pennsylvania for consumption, and that the Philadelphia Electric Company is prohibited by its charter from doing business outside of Pennsylvania, created difficulties in the way of constructing the project which are of more than ordinary interest, and which ultimately resulted in the Federal Power Commission exercising, for the first time, its authority to control the issue of securities for the construction of a project being built under its license. Three subsidiary corporations of the Philadelphia Electric Co. have been organized; the Susquehanna Power Co., incorporated in Maryland, will own all the physical property located in that state; the Philadelphia Electric Power Co., incorporated in Pennsylvania, will own all the physical property in connection with the project in Pennsylvania, and also all the stock of the Susquehanna Power Co. The voting stock of the Philadelphia Electric Power Co. is all owned by the Philadelphia Electric Co. The third company, the Susquehanna Electric Co., was formed for the purpose of leasing, for the term of the license, the properties of the Susquehanna Power Co. in Maryland, and will operate the plant and

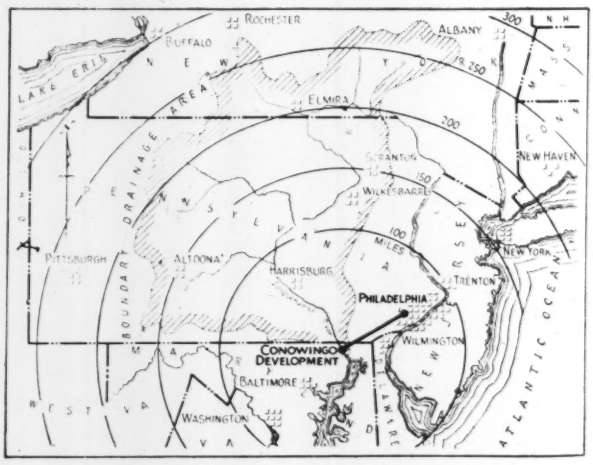


FIG. 2—DRAINAGE AREA OF THE SUSQUEHANNA RIVER

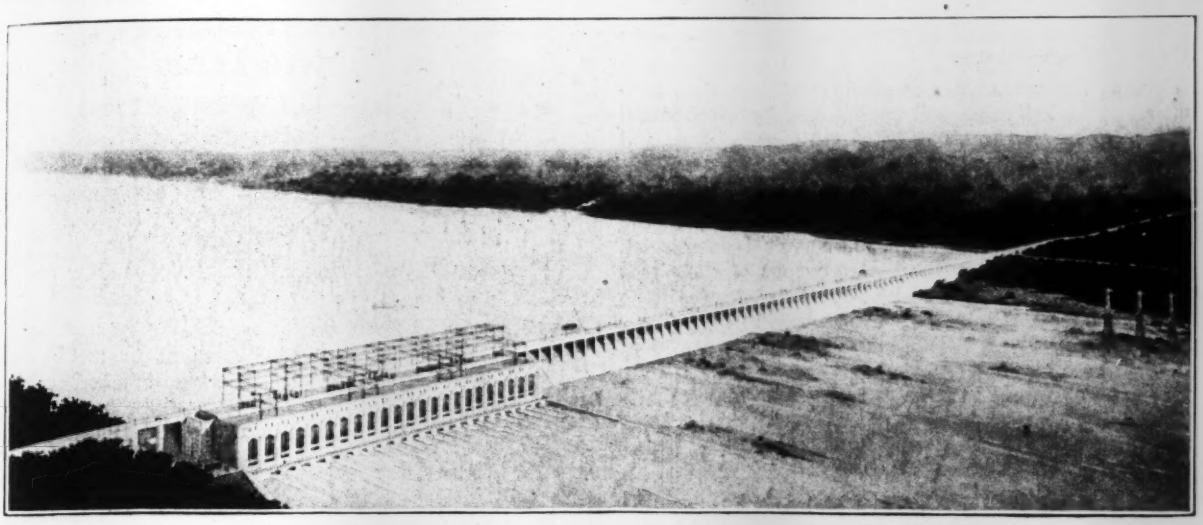


FIG. 3—ARTIST'S SKETCH OF COMPLETED DAM AND POWER HOUSE

sell the energy to the Philadelphia Electric Co. All the stock of this company is owned by the Philadelphia Electric Co.

Power Possibilities of the Site—Conowingo is 14

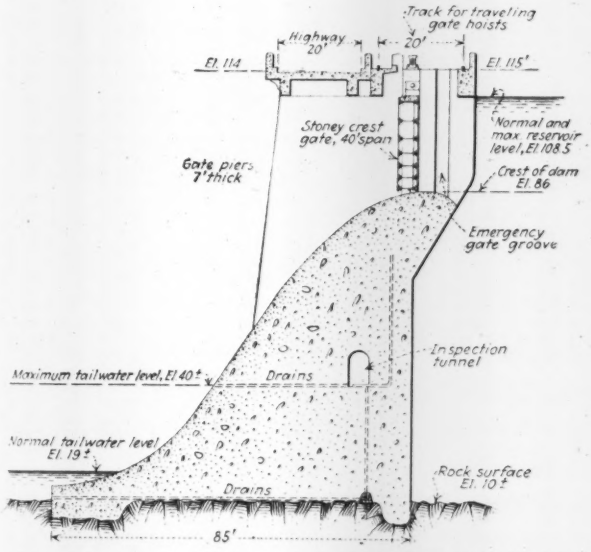


FIG. 4—TYPICAL SECTION THROUGH THE SPILLWAY

miles from the mouth of the Susquehanna River, and about 4 miles above tidewater. The river at this point flows through a shallow gorge of granite rock about a mile wide. Test borings show continuous solid rock across the site.

The drainage area of the Susquehanna River above Conowingo is 27,000 sq.mi., including a large part of Pennsylvania and part of southern New York State, as indicated in Fig. 2. The river is subject to a wide variation of flow; the maximum recorded flow being 750,000 sec.-ft. in 1889, and the minimum 2,500 sec.-ft. The dam will provide a storage capacity of about 2,500,000,000 cu.ft. in the reservoir which will extend up the river to tail-water of the Holtwood plant near McCall Ferry, a distance of 13 miles. With this storage capacity the low flow can be increased to 4,650 sec.-ft., and by using water during periods of low flow to carry only the peak load at Philadelphia, it will be possible by 1930 to replace at least 190,000 kw. of steam plant capacity at Philadelphia. During periods of ample flow, the situation will be reversed. The base load of the Philadelphia system, to the extent of the 231,000 kw. obtainable from Conowingo, will be carried by that plant, and the peak load will be carried by the steam plants at Philadelphia.

Tail-water elevation at Conowingo will be 19 ft. above sea level, and the crest of the dam will be at El. 86, but the use of crest gates will make it possible to maintain the normal reservoir level at El. 108.5.

The Dam—The dam is to be a gravity-section concrete structure approximately 4,800 ft. long and 104 ft. high from rock level to the roadway at the highest point. The power house is being built into the west end of the dam, and will be approximately 176 ft. wide and 950 ft. long when all the units have been installed. The midstream section of the dam is to be a spillway 2,385 ft. long, with fifty openings 38 ft. wide and 22½ ft. high, controlled by Stoney gates, and three openings 38 ft. wide and 10 ft. high, controlled by roller gates. The spillway will provide for a flood flow of 880,000 sec.-ft., 130,000 sec.-ft. in excess of the maximum recorded flow.

A 20-ft. roadway and 20-ft. gage track for the traveling gate hoist will be located on top of the piers between the crest gates. The east end of the dam is of non-overflow section, with piers carrying the roadway.

The first waterwheels to be installed will be seven units of a capacity of 54,000 hp. each, at full gate opening, 89 ft. normal net head, and 81.8 r.p.m., and having a capacity of 50,000 at the point of best efficiency. They will be vertical shaft, single runner, Francis reaction type runners, and will be the largest units, in physical dimensions, yet built. Four of these units are to be supplied by the Allis-Chalmers Manufacturing Co., and three by the William Cramp & Sons Ship & Engine Building Co.

Two station service waterwheel units of 1,900 hp. each, 89-ft. normal net head and 360 r.p.m. are to be supplied by the S. Morgan Smith Co.

Each main waterwheel unit will be fed through a

27-ft. butterfly valve capable of operating under an 84.5-ft. head on the center of the valve. They will be operated by oil pressure.

Four of the seven main generators, 40,000 kva., generating at 13,800 volts, will be supplied by the General Electric Co., and the other three main generators and the two service generators will be supplied by the Westinghouse Electric & Manufacturing Co.

The switching station is to be located on top of the power house. From it two 220,000-volt transmission lines, each able to carry the entire output of the plant, are to be built to Philadelphia. A third line will be added when the last four units are installed in the power house.

The ultimate installation will be 11 units of 54,000 hp. each. Provision for the four additional units is being made in the head-works and in the foundations of the power house as part of the present undertaking.

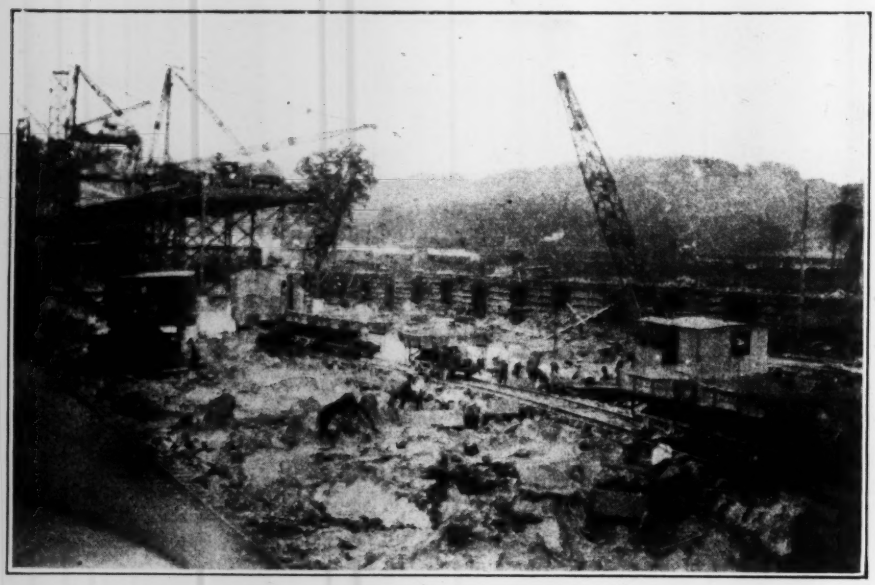


FIG. 5—EAST COFFERDAM FOR CONOWINGO HYDROELECTRIC PLANT ON THE SUSQUEHANNA

Cofferdam built with stop-log openings to pass the spring floods in 1927. Steel construction bridge with gantry cranes at the left.

Contracts for the design and construction of the dam and power house were awarded to Stone & Webster, Inc. A sub-contract for the construction of the eastern portion of the dam subsequently was awarded to the Arundel Corporation of Baltimore, and this company has also been awarded the contract of relocating the tracks of the Columbia & Port Deposit branch of the Pennsylvania R.R. Two complete construction camps have been erected at the site, one on each side of the river, as the operations on each side are being carried on independently, and there is no direct connection between the two sides at the present time. Contract for the design and construction of the transmission line and the switching station on the roof of the power house has been awarded to Day & Zimmerman, Inc., of Philadelphia.

The construction and subsequent operation of the development is being carried out under the direction of Dr. William C. L. Eglin, vice-president and chief engineer of the Philadelphia Electric Co.

Irrigation with Treated Sewage in Western Texas

Effluent from Tanks and Sprinkling Filters of Lubbock Pumped to Reservoir and Used on Cotton and Other Crops

By H. N. ROBERTS
Of Hawley & Roberts, Consulting Engineers, Ft. Worth, Texas
and DON L. JONES
Director of Agricultural Experiment Station, Lubbock, Texas

A SEWAGE FARM of 100 acres has been receiving the effluent from the sewage-works of Lubbock, Texas, since February, 1926. Previous to this year, the effluent from these works, consisting of Imhoff tanks, sprinkling filters and a secondary settling basin, was discharged into Double Mountain Fork Canyon, the bed of which is dry nearly the year around. This gave rise to complaints from landowners who claimed loss of fish with which pools had been stocked and the city was advised by its consulting engineers to buy 100 acres two miles southwest of the city to receive the treated sewage.

The territory surrounding Lubbock, and most of the Panhandle section of Texas, is a region of scant rainfall, the normal being about 20 in. annually. The soil is fertile, being classified by the U. S. Bureau of Soils as a fine, sandy loam belonging to the Amarillo Series. In years of normal rainfall, excellent and plentiful crops are produced. Near many of the towns of West Texas, there is no water available to receive sewage, except large "sinks" in the land with no outlet to any stream or watercourse. Water under the control of the farmer, is, in this region, an asset not to be overlooked.

There was accordingly installed the necessary equipment to do this at the following cost: 100 acres of land, $12,500; pumping equipment, $2,000; 10-in. cast-iron outfall, $13,200; reservoir and canals, $3,000; total

TABLE I—ACREAGE OF VARIOUS CROPS IRRIGATED WITH EFFLUENT FROM LUBBOCK SEWAGE-WORKS

Plot*	Crop	Acres	Condition
1	Red top cane	10	Excellent
2	Cotton	4	Average
3	Cotton	12	Very good
4	Pop corn	3	Very good
5	Milo maize	9	Very good
6	Corn	9	Excellent
7	Cotton	25	Very good
8	Watermelons	2	Good
9	Corn	3	Excellent
10	Beans	1	Good
11	Sudan grass	2	Good
		80	

* The northern part of the land has a natural slope to the east of 6 ft. per 1,000 The southern part slopes to the east at the rate of 3 ft. per 1,000 ft. Plots numbered beginning at the north and going east clockwise.

HEADGATE AND CANAL FROM SEWAGE RESERVOIR

$30,700. The cost of pumping against a total head of approximately 45 ft. is $2.60 per million gallons of sewage; the investment cost is $307 per acre, and the cost per acre, per year, including interest and pumping cost, is $21.37.

A 1-m.g. earth reservoir, holding a little over two days' sewage, is 209 ft. inside diameter, with a 4-ft. water depth, and a 6-ft. total height. It is equipped with two outlet structures with 16-in. square sluice gates. The canals consist of a 12-ft. wide embankment of varying height (not over 2 ft.), and in this embankment is cut a ditch approximately 18 in. deep with a 1½ to 1 side slope. The ditch is designed to carry 2 ft. per second with a slope of 3.9 ft. per mile, or 1 in 1,350; the velocity is about 1 ft. per second. The irrigators seem well satisfied with the grades, velocities and quantities provided for them for this soil. There were no deposits or growths in the ditches.

The land has been leased by the city at a nominal annual rental to private parties, and when visited by the authors on July 7, 1926, the crops and conditions found were as shown in Table I. Not the slightest odor or other bad feature was noticed during any part of the inspection trip, except the light green color of the clear sewage in the canals, which would lead any one to suppose that the farm was in any manner connected with a sewage plant.

The outward flow from the sewage-works to the irrigated land is recorded on a weekly chart by means of a recording weir. This flow averages about 0.35 m.g.d. or 1.05 acre-feet per day. The total land that has taken the entire sewage flow from February to July is 80 acres. The daily sewage flow is equivalent to an average of 4.7 in. per month, per acre, provided that each of the 80 acres were irrigated equally; assuming a 40 per cent loss through seepage and evaporation in the reservoir and canals, this would leave 3 in. per month per acre going on the crops.

MILO MAIZE ON LUBBOCK SEWAGE FARM
Nine acres of this crop under treated sewage in 1926. See Table I for averages of other crops.

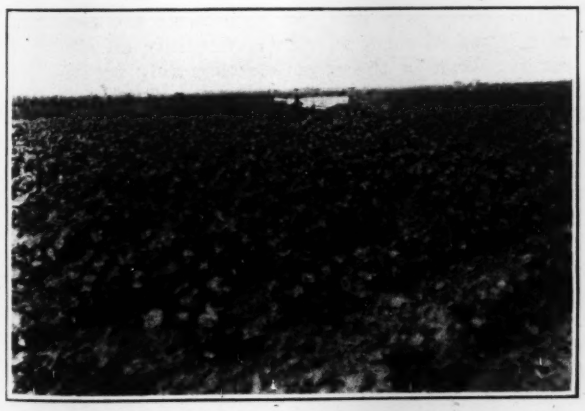
The growing period in this region is from April 15 to Oct. 15, during which time the normal evaporation from water surface is 43 in. Some 80 per cent of the total annual rainfall takes place during this period. The evaporation, rainfall, and mean monthly temperatures since the farm has been in operation, as recorded by the Agricultural Experiment Station located three miles east of Lubbock, are shown in Table II. It will be seen that the rainfall, less evaporation from land surface, is 1.5 in. greater than the transpiration for this period, and that there has been considerable residual water left in the soil, and the question as to whether this will eventually sour, or waterlog, the soil naturally arises. The authors do not attempt to answer this question, but will state that in the South Plains of the Texas Panhandle there are many so called "wet weather lakes," or depressions in the ground, of sometimes very large extent, which have no outlet; at times these depressions are filled with water from surface runoff, and remain full for long periods of time until evaporation and seep-

TABLE II—TEMPERATURE, RAINFALL AND RAINFALL DISTRIBUTION AT LUBBOCK SEWAGE FARM

Temperatures in degrees Fahrenheit; other figures in inches.

Month	Mean Temperature	Rainfall	Evaporation from Water Surf.	Evaporation from Land Surf.*	Transpiration†	Irrigation	Net to Crop	Residual to Soil
February	49.1	0.0	3.6	0.2	0.0	3.0	2.8	2.8
March	48.2	1.6	3.3	0.8	0.0	3.0	3.8	3.8
April	55.0	1.8	4.1	1.0	0.4	3.0	3.8	3.4
May	66.6	5.1	6.0	2.4	1.1	3.0	5.7	4.6
June	75.4	1.1	7.2	0.8	1.4	3.0	3.3	1.9
Total	....	9.6	24.2	5.2	2.9	15.0	19.4	16.5

* From Meyer's "Elements of Hydrology" diagram p. 422. † Do., same, pp. 244, and 262.



COTTON UNDER IRRIGATION WITH EFFLUENT FROM SEWAGE-WORKS OF LUBBOCK, TEXAS
Canal headgate in background. View taken July 9, 1926, of Plot 3 (see Table I), 12 acres in extent. Two other plots, one of 12 and one of 4 acres, were under treated sewage this year, besides various other crops (see Table 1).

age eventually dry them up. After they are dry the farmers get bumper crops in these lake bottoms, so there is little danger of the "water logging" of the soil.

The soil of the South Plains is a fine, loose, sandy loam underlain by a sandy clay derived from the Tertiary and Pleistocene formations, which is further underlain at a depth of from 2 to 6 ft. by a spongy lime formation locally called "caliche." These formations seem able to assimilate very large quantities of water, and also seem to have the paradoxical quality of being able to retain a small rainfall for a long time and yet raise large crops. The blacker, more clayey soils, such as that of the Randall Series, also encountered in West Texas, would behave quite differently in these respects. The irrigators further state that February irrigation is very important, and that they can detect to a row where February irrigation was used.

One of the greatest assurances of good crops in the South Plains is to begin the planting season with good soil moisture; good crops can be raised on less moisture later on; therefore during the coming winter and early spring the sewage flow will be used to irrigate the fall wheat and prepare other sections for spring planting.

Hawley & Roberts, consulting engineers of Ft. Worth and Lubbock, have been the city's advisors on this project as well as on all phases of the large construction program undertaken and carried through by the city of Lubbock since 1924, and they were ably assisted during the preliminary studies of the sewage farm project by Robert E. Karper, then Director of the Agricultural Experiment Station at Lubbock.

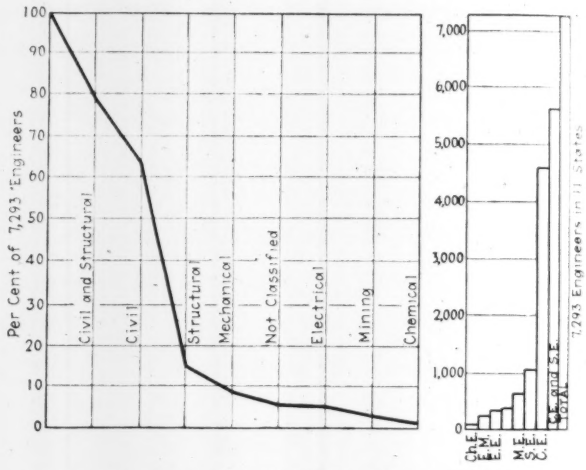
Present Status of Registration of Engineers

In 25 States Having Laws, 27,277 Engineers and Surveyors Have Registered of Whom a Majority Are Civil Engineers

By Arthur Richards
City Planning Engineer, Altoona, Pa.

THE TIME of the year is approaching when city, state and national engineering societies again will take up the subject of registration for profressional engineers and land surveyors. The various state legislatures will convene during the present winter and in about a dozen of the states registration laws will be proposed. As most of the states which now have such laws have had five or more years' experience with their enforcement, it is well to inquire as to the success of the movement and as to what branches of engineering are best represented by the registrants. The following tabulations, compiled by the writer in conjunction with the American Association of Engineers, represent an attempt to secure and analyze data regarding the present status of registration in order that other states contemplating enacting registration laws may have some idea of what to expect after their proposed laws become effective.

In the 25 states listed, which include Hawaii, there are 27,277 registered engineers and surveyors. The same states in 1926 contain about 39,000 engineers who are members of the national civil, mining, mechanical and electrical engineering societies and the American Association of Engineers. The 1920 government census shows about 90,000 engineers and surveyors living in the 25 states. These figures will give an indication of the proportion of engineers in each state who consider themselves qualified to be, or desire to become, registered. These states contain about 60 per cent of the population of the United States; over 55 per cent of the number of engineers and surveyors listed in the 1920 census; and about 70 per cent of the members of the above mentioned five national engineering societies. These societies at present have a



CLASS DISTRIBUTION OF REGISTERED ENGINEERS
Based on data from 11 registration states.

membership of about 56,000 in the United States and 6,000 in foreign countries.

The tables give information from only eleven of the states regarding the number of registrants in the various branches of engineering. Information could not be secured from the other states as no records are kept in most of them as to the engineering branch of the members. The accompanying chart therefore shows the kinds of engineers registered in only eleven states and embraces only 7,293 of the total number of registered engineers, which number is about 24,000. About 78 per cent of the registrants are civil engineers, if the structural engineers are included in the general civil group; if not, then 63 per cent. The mechanical engineers represent less than 9 per cent, the electrical about 5, and the mining less than 3 per cent.

Since more than half the registrants are civil engineers it would seem wise to concentrate all efforts on securing laws in the other states purely for the profession of civil engineering. The work of civil engineers is more directly related to or connected with the public and the public welfare than that of any other group of engineers, and complete success in the registration of civil engineers and land surveyors would have a very great influence on forming the opinion of the public regarding the work of the entire profession of engineering. Such registration laws should be compulsory and strictly enforced; and then after the civil engineers and surveyors have improved their professional and economic welfare through these rigid laws, the other branches of the profession could follow suit if they so desired.

The problem of reciprocal registration between the states has not been properly developed, due primarily

to lack of co-operation between the engineers of the various states and to the lack of leadership by the national engineering societies to devise and protect the movement toward registration. Registration in any state should qualify an engineer to practice in all the other states upon presentation of credentials. To force an engineer to take an examination in a number of states in which he may want, or be required, to work; to make him pay in each state an entrance fee of from $10 to $25 and annual fees of $1 to $10, indicates a woeful lack of consideration for the personal interests of the engineer.

At present 18 of the 25 states are members of the National Council of State Boards of Engineering Examiners. This Council is a voluntary organization, its purpose being to examine the state laws providing for registration of engineers, to consider suggestions for uniformity of practice by the different state boards, and to provide for reciprocal relations between the state boards for granting registration to applicants from other states on equal terms of examination. Reciprocal relations with Canada, where at present seven provinces have engineering registration laws, are planned.

Of the 25 states 21 have compulsory registration and it would seem this would be the best policy to adopt if there is to be a truly legal status of the profession.

Some question the advisability of including the registration of land surveyors with professional engineers, but those who are familiar with the chaotic condition of land surveys and deed records in cities and counties realize that some action must be taken if the situation in the future is to improve on conditions of the present. Thousands of needless cases reach the courts each year regarding the determination of land or lot boundaries, and while regulations of city planning commissions respecting the platting of land might help in cities which have planning commissions, still most of the cities and counties have no provisions to regulate who shall make property surveys and how the surveys shall be made and referenced.

As to whether or not the registration laws which are in effect have been successful can be gleaned from the replies to three questions which were sent to the registration boards of the 25 registration states.

(1) Of 16 states replying to the question, "How many applicants have been refused?" 2 refused no applicants, 4 refused 3 per cent, 3 refused 5 per cent, 4 refused 10 per cent, 2 refused 15 per cent and 1 refused 20 per cent. If the states are combined then the number of applicants refused was 13 per cent, or 2,440 persons.

(2) Of 19 states, 15 reported that the law was being observed in a good manner, 4 thought the observance was indifferent, but none thought it was poor. In 17 of the states there were only 3 arrests and 1 conviction. One reply which stated that the law was being observed in an indifferent manner said that this could be corrected if the law was properly enforced and violators vigorously prosecuted.

(3) On the question, "Has the law tended to increase the compensation of registrants?" 9 say yes, 4 believe it has, and 3 say no. One of the negative replies states that the law "probably has not increased compensation as that is not the object of the law," while another states: "We hope not. The law is intended to benefit the public and not any one class." Other replies however are much more optimistic and agree that the laws have raised the status of many engineers, have increased the amount of work for registered engineers, and decidedly have tended to increase the salary budgets for engineering service. One state, having optional registration, does not believe the law will especially help engineers, but the other 16 states which replied to the last question are very much of the opinion that the registration laws will be a success and will be of great benefit to the engineer and the profession.

In the past ten years 23 of the states have enacted registration laws, and as the movement is toward action by the other states it would appear that within the coming ten years all the states of the Union will have some form of registration.

The leadership for the continuation of the movement properly rests with the national and state engineering societies. The time has arrived for concerted action in order that the best interests of the public, the profession and the engineers and surveyors shall be properly conserved.

REGISTRATION OF ENGINEERS IN 25 STATES BY CLASSES, WITH INCIDENCE OF LAWS AND FEES CHARGED

	State	Eng.	Surv.	Total	Civil	Min.	Mech.	Elec.	Struc.	Chem.	Others	Comp.	Opt.	Eng.	Surv.	Effec.	Entrance Fee		Annual Renewal Fee	
																	Eng.	Surv.	Eng.	Surv.
1	Arizona	261	6	267								*		*	*	1921	15	10	5	5
2	Arkansas	219		219	196	9	7	6		1		*		*		1925	25		5	
3	California		1,600	1,600									*		*	1891		10		0
4	Colorado			500								*		*	*	1919	15	15	5	5
5	Florida	875		875	740	4	45	25	55	6		*		*		1918	25		5	
6	Hawaii	123	57	180								*		*	*	1923	15	15	2	2
7	Idaho	251	49	300	251							*		*	*	1919	10	5	2	2
8	Illinois	840		840					840			*		*		1916	15		1	
9	Indiana	881	28	909	571	21	95	100	83	11		*		*	*	1921	25	25	10	10
10	Iowa			1,310								*		*	*	1919	25	25	0	0
11	Louisiana	375	50	425	375							*		*	*	1908	25	25	3	1
12	Michigan	1,287	139	1,426	843	43	153	40		26	182	*		*	*	1919	20	20	1	1
13	Minnesota	288	24	312									*	*	*	1921	25	10	5	2
14	New Jersey			1,386								*		*	*	1922	25	25	1	1
15	New Mexico			250								1		*	*	1917	5	5	0	0
16	New York	8,000	500	8,500								*		*	*	1920	25	25	1	1
17	North Carolina	643	109	752								*		*	*	1921	25	10	5	5
18	Oregon	1,682		1,682	1,005	85	203	125	39	14	211	*		*		1919	15		3	
19	Pennsylvania	2,959	325	3,284								*		*	*	1921	20	20	1	1
20	South Carolina			283										*	*	1922	25	25	1	1
21	South Dakota	100	50	150								*	*	*	*	1925	25	15	5	5
22	Tennessee	300		300								*		*		1922	25		5	
23	Virginia	546	140	686	360	20	92	68		6		*		*	*	1920	25	25	5	2 50
24	West Virginia	239		239	160	25	23	20	8	3			*	*		1921	20		10	
25	Wyoming	98	54	152	98							*		*	*	1922	15	15	2 50	2 50
	Total	19,967	3,131	27,277	4,599	207	618	384	1,025	67	393	21	4	24	19					

Jetties of 5- to 10-Ton Precast Blocks Built in Florida

Protect Ocean End of Newly Dredged Channel Which Will Aid in Clearing Sewage From Lake Worth

By Kennerley Bryan
Chief Engineer, Riddle Engineering Co., West Palm Beach, Fla.

AN INTERESTING jetty building job has recently been completed in connection with dredging the South Lake Worth inlet, a project designed to clear the lake of the sewage discharged into it by several of the rapidly growing Florida east coast cities. Because of the lack of natural material suitable for jetty construction, the contractor designed a precast concrete block structure and constructed it under considerable difficulty because of the force of the ocean surf.

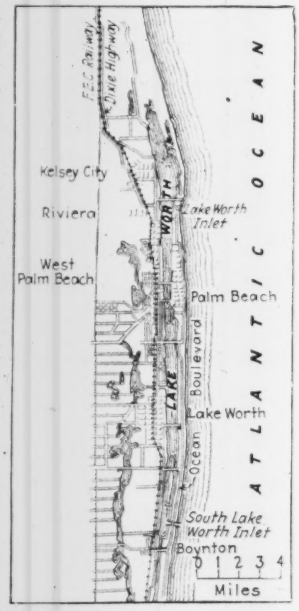


FIG. 1—LAKE WORTH, FLA. Showing the inlet being dredged at southern end of Lake Worth to connect it with the Atlantic Ocean.

Lake Worth is a body of water about 21 miles long with an average width of about ¾ mile. It is bordered on the east by a strip of land, averaging about a half mile in width, which separates the lake from the Atlantic Ocean; the western shore of the lake is the mainland of the east coast of Florida. Palm Beach, Lake Worth and Boynton are located along the eastern shore, while Kelsey City and West Palm Beach are the large cities on the western side. The map Fig. 1 gives a general idea of the region that surrounds the lake.

The sewage from this entire area of about 75 sq.mi. flows, after treatment, either directly or indirectly into Lake Worth and the ultimate dispersal of this sewage effluent has been a grave problem and one which has for a number of years engaged the attention of the authorities of the cities and towns bordering the lake. The only tidal inlet to the lake heretofore has been at the north end so that the lower or southern end was rapidly becoming seriously contaminated. Early in 1924 an act of the state legislature created the South Lake Worth Inlet District and provided for levying a tax on all property in the district to secure money to pay for and maintain the work of dredging an inlet near the southern end of the lake.

The general construction problem prescribed the following requisites: the inlet channel had to be protected both on the ocean and on the lake side; the channel had to be bridged to carry Ocean Boulevard, one of the scenic highways on the east coast of Florida; and the material dredged from the channel had to be disposed of in such a way that it would not wash back. Nothing of unusual interest arose in connection with the dredging of the channel so that the jetty construction was the novel feature of the entire work.

Jetty Construction—To protect the channel it was decided to build jetties into the ocean and bulkheads on the lake side. At the site of the work there was no material available of sufficient weight or density with which to build jetties and transportation of such material to the job would have involved great expense.

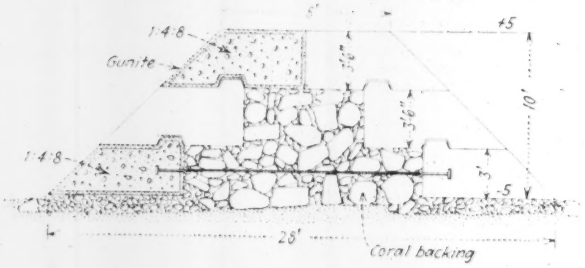


FIG. 2—TYPICAL CROSS-SECTION OF JETTY MADE OF PRECAST CONCRETE BLOCKS

The contractor therefore designed a type of construction using concrete blocks, laid up in somewhat the manner that granite blocks would be laid. The details of these blocks are shown in Fig. 2. Of special significance are the keys used in the blocks which were found to be effective in binding the structure solidly together as well as being of great assistance in setting the blocks to correct lines.

Blocks were poured into wooden forms, a 1:4:8 mix of concrete being used and a 1:3 mix of gunite being applied as a protective coating. The only reinforcing used was a 4x4-in. welded mesh of No. 8 wire as a base for the gunite protection. Wire cable rods were built into the blocks as an aid to the crane in placing them.

The ocean bedrock was sufficiently near the surface to permit excavating the sand lying upon it. This was done and a subgrade of one-man size coral rock was laid directly on the bedrock. Upon this foundation the jetty blocks were set. The character of the coral rock

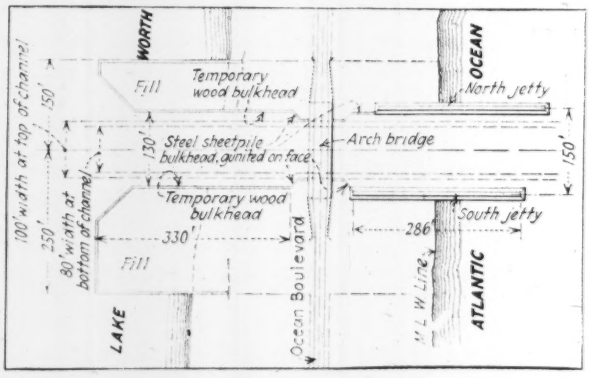


FIG. 3—PLAN OF LAKE WORTH INLET CHANNEL

is such that its immersion in water causes it to cement together and form a hard solid mass. This subgrade was extended beyond the edges of the lowest course of jetty blocks. Coral was also used as a core for the jetty, the core and the subgrade cementing together and forming a solid body inside and under the blocks.

The jetty blocks weighing from five to ten tons each, were set by means of a traveling crane operating on rails placed on top of the jetty, as shown in Fig. 4. The

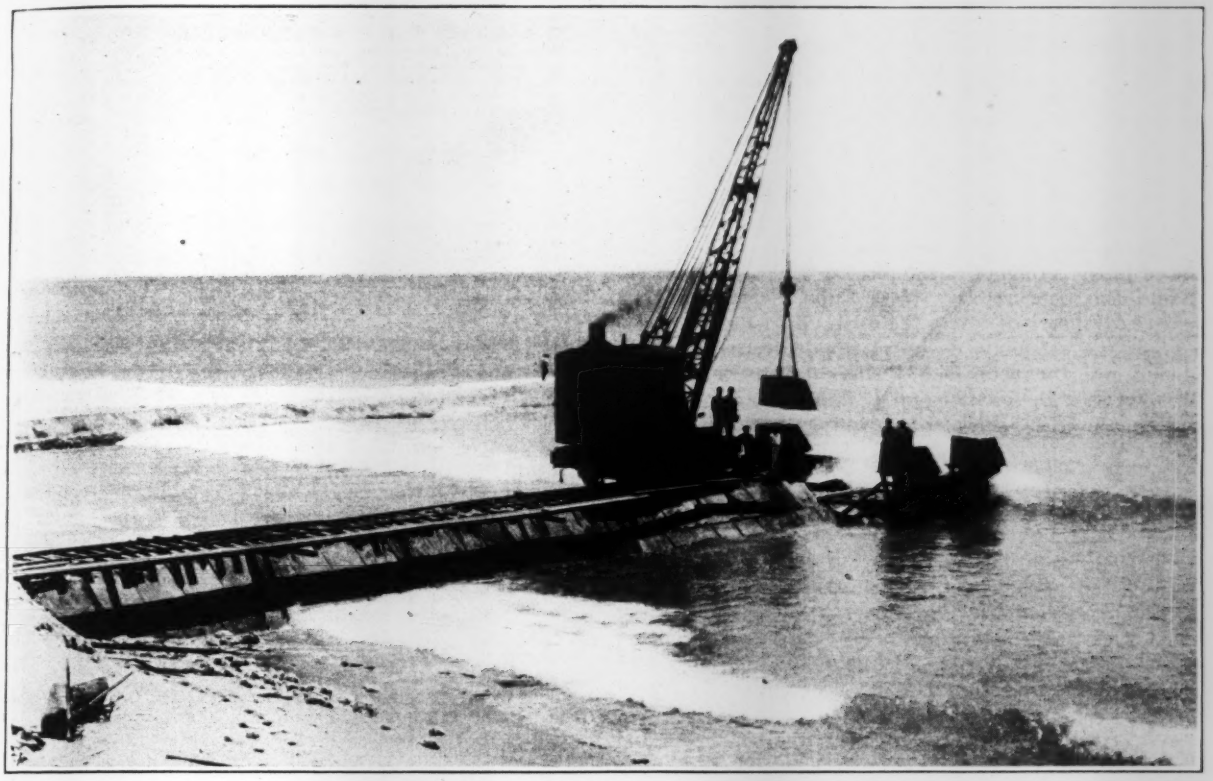


FIG. 4—CONSTRUCTING JETTY OF PRECAST CONCRETE BLOCKS FOR PROTECTING SOUTH LAKE WORTH INLET

north jetty was built first and as construction started seaward, it was found that the roughness of the ocean seriously impeded progress and made the work dangerous for the workmen. A movable cofferdam was then designed—as shown off the end of the jetty in Fig. 4—which when placed in position broke the force of the waves and permitted the work to proceed with greater rapidity. It was handled and moved by the crane. The cofferdam was of timber and of sufficient size to permit a length of about 20 ft. of jetty to be built at each setting. By using this cofferdam, the south jetty was completed in just thirty days. Jetty blocks were used to weight down the cofferdam.

The entire sufficiency of the design and construction of these jetties was thoroughly demonstrated during the hurricanes which visited the east coast of Florida on July 26 and 27 and on Sept. 17 and 18, 1926. During the height of these storms, waves 20 to 25 ft. high broke over the ends of the jetties without appreciably damaging them, although several unsecured blocks were later found buried in the sand from 50 to 150 ft. from the original location. These unsecured blocks represented a surplus which had been placed in an arc around the outer end of each jetty. They were set into the sand on top of the bedrock. The extreme end of the subgrade of the north jetty was washed out, letting the end tier of blocks down about one foot where it rested on the ocean bedrock. The subgrade at this point had been in place but about two months and it is believed had not had sufficient time to cement together. No damage of any kind was done to the south jetty.

The two jetties contain 1,808 cu.yd. of concrete, 560 cu.yd. of core stone and 1,666 cu.yd. of rock subgrade. It is believed that this design and method of construction afford a means of building such jetties rapidly and economically. The cost of the completed jetties was $109,000.

The bridge spanning the dredged inlet channel and carrying Ocean Boulevard, is of the rainbow type, built

FIG. 5—CONCRETE COVERED STEEL ARCH BRIDGE OVER SOUTH LAKE WORTH INLET CHANNEL

with structural steel arch ribs and floorbeams, all encased in reinforced concrete. The floor and sidewalk are of reinforced concrete. Because of the rapid deterioration of exposed concrete in this climate the entire structure was covered with reinforced gunite. The bridge has a clear span of 100 ft., a clear width of roadway of 24 ft. and two 5-ft. sidewalks. The abutments are of reinforced concrete placed on wood pile foundations. The bridge was built at a cost of $85,000.

The bulkheads on the lake side of the channel are

built of timber with the idea that at a later date they will be replaced with concrete. They extend about 200 ft. into the lake. The material excavated from the channel is thrown behind the bulkhead and the new land thus made is to be used as a park by the town of Boynton in which the work is located. The channel, which is still under construction, will be 100 ft. wide at low water and 80 ft. wide at the bottom, which is set at El. —5. The bridge has 22-ft. clearance above mean low water.

Administration—The handling of the project was placed in the hands of a commission which retained the Riddle Engineering Co., West Palm Beach, Fla., as project engineers to design the inlet. Karl Riddle, president of the company, designed the jetty construction. The general contractor is A. Bentley & Sons Co., Toledo, Ohio, with G. D. Auchter and J. T. Monahan in general charge and H. C. Howard superintendent.

South End of Lake Michigan Badly Polluted

SERIOUS pollution by sewage of some of the public water supplies drawn from the southern end of Lake Michigan, particularly from the Indiana section of the territory, is recorded in the "Report on an Investigation of the Pollution of Lake Michigan in the Vicinity of South Chicago and the Calumet and Indiana Harbors," made by the United States Public Health Service in co-operation with the Sanitary District of Chicago, the Chicago City Department of Health and the State Boards of Health of Indiana and Illinois during 1924-25. The report was written by H. R. Crohurst, sanitary engineer, and M. V. Veldee, past assistant surgeon, U. S. Public Health Service.

The study included a survey of the sources and extent of domestic and industrial waste pollution, a systematic collection and examination (physical, chemical and bacterial) of water samples from a wide area of the lake at frequent intervals for a whole year and the systematic examination of daily samples of raw and treated waters from the various municipal water supplies taken from the lake. Pertinent meteorological conditions were also considered.

The present condition of these raw and treated lake water supplies is summarized in the accompanying table from the report. The conclusions from the study are:

The pollution of Lake Michigan by sanitary sewage and industrial wastes discharged from the Calumet District in Illinois and Indiana, especially from Indiana, is such as to render the sources of water supply now used by Hammond, Whiting and East Chicago unfit for that purpose, even with elaborate and efficiently operated purification plants.

The source of water supply of Gary, Ind., though lying outside of the zone of grossest pollution, is also seriously contaminated but not beyond the capacity of modern purification processes to safeguard it.

The water supplies drawn by Chicago from the 68th St. and Dunne cribs are also affected and at times may be seriously endangered by sewage pollution from the Calumet District.

The water supplies taken from the lake north of the Chicago River appear to be beyond the zone of pollution from the Calumet District and are receiving water of such quality that it can be satisfactorily purified by artificial processes, excepting the supplies of Waukegan and Lake Forest. Although the pollution of the latter supplies is in no way chargeable to the Calumet District, and its discussion is beyond the scope of this report, the existing pollution in this area demands attention and abatement.

If the use of the lake as a source of water supply for the urban population in the area south of the Chicago River is to be continued, as seems inevitable, it is necessary, in the interest of public health, that the water supply intakes be protected. To remove the intakes beyond the zone of at least occasional gross pollution would require their extension very far into the lake, to a distance which is probably not practicable. Moreover, in the absence of remedial measures it is to be anticipated that the existing zone pollution would be extended, with increase in the population and development of the adjacent land area. Therefore, the obvious remedy for the present intolerable situation is abatement of the existing pollution of the lake.

The choice of methods to achieve this end involves engineering and economic problems which it is not within the province of this report to discuss. There is no question, however, that abatement of the existing pollution is possible, notwithstanding the difficulties which it may present; and it is certain that the need is imperative.

The report is available only in mimeograph form, obtainable for $3.40 from Officer in Charge, Stream Pollution Investigations, U. S. Public Health Service, Cincinnati, Ohio.

B. COLI IN WATER OF SOUTHERN LAKE MICHIGAN

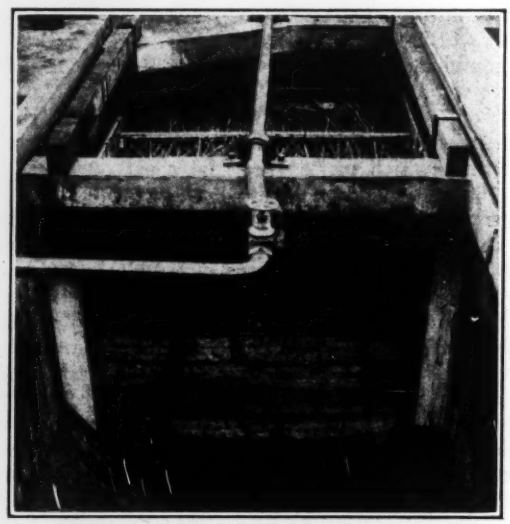
Summary of B. coli indices of raw water and treated effluents of municipal water supplies taken from Lake Michigan in the Chicago and Calumet areas. Figures given are means of observations made 5.7 times weekly during 12 months ending Nov. 1, 1925. (From Table 29, Crohurst and Veldee's report)

Water Supply	Distance of Intake from Shore, Yards	B. Coli Index (B. Coli per 100 c.c.) Raw Water	Treated Effluent
Waukegan, Ill.	200	3,400	10.9 (2)
Lake Forest, Ill.	393	2,627	0.9 (1)
Evanston, Ill.	1,330	57	0.03 (1)
Chicago, Ill. Wilson crib	5,301	10	0.02 (2)
Harrison crib.	4,678	11	0.03 (2)
Four Mile crib.	6,870	4	0.01 (2)
68th St. crib.	3,527	50	0.02 (2)
Dunne crib.	3,527	13	0.04 (2)
Hammond, Ind.	1,700	9,911	4.7 (2)
Whiting, Ind.	400	8,876	1.1 (1)
	200 (*a*)		
East Chicago, Ind.	800 (*b*)	8,507	0.5 (1)
Gary, Ind.	2,640	55	2.6 (2)

(*a*) Used from Dec. 15, 1924, to March 15, 1925.
(*b*) Used for the remainder of the year.
(*c*) One count of 10,000, which apparently was a sampling error, was omitted. This one included gives a mean B. coli of 37.
(1) Treatment consisting of filtration and chlorination.
(2) Treatment consisting of chlorination only.

Sewage Contact Aerator Installed in Old Two-Story Tank

THE accompanying view of a contact aerator, installed in an old two-story sewage tank, was received too late for use in the article by Dr. Karl Imhoff, published in *Engineering News-Record*, Dec. 9, 1926, p. 948. It is described by Dr. Imhoff as a "wooden box, filled with brushwood."



VIEW OF SEWAGE CONTACT AERATOR

Experience in Welding Structural Steel and Some Conclusions

Welding Applied to Steel Parts Built Up to Replace Gray-Iron Castings for Machine Bases and Frames—Results Highly Satisfactory

By Robert E. Kinkead

Engineer, Lincoln Electric Co., Cleveland

TODAY there is little question about the possibility of welding the steel in a building instead of riveting it. Safety and relative cost, however, continue to be open questions, which cannot be disposed of as easily in structural work as in industrial applications of welding. Advocates of welding for buildings must face searching inquiry into the economy and safety of welded connections, inquiry sometimes inspired by open hostility.

With these facts in mind, several years ago our organization concluded that the best way to find out the essential facts of structural welding is to do structural welding on a large scale, even though it would have to be done mainly on other than building steel. Several years of large-scale welding operations, it was hoped, would develop sufficient information to prove whether or not welding could be recommended as safe and economical for building construction. The opportunity for this development welding was at hand in connection with certain machinery and equipment we build in our own plant, where the gray-iron castings used for the machine bases, frames and parts could be replaced by welded steel parts.

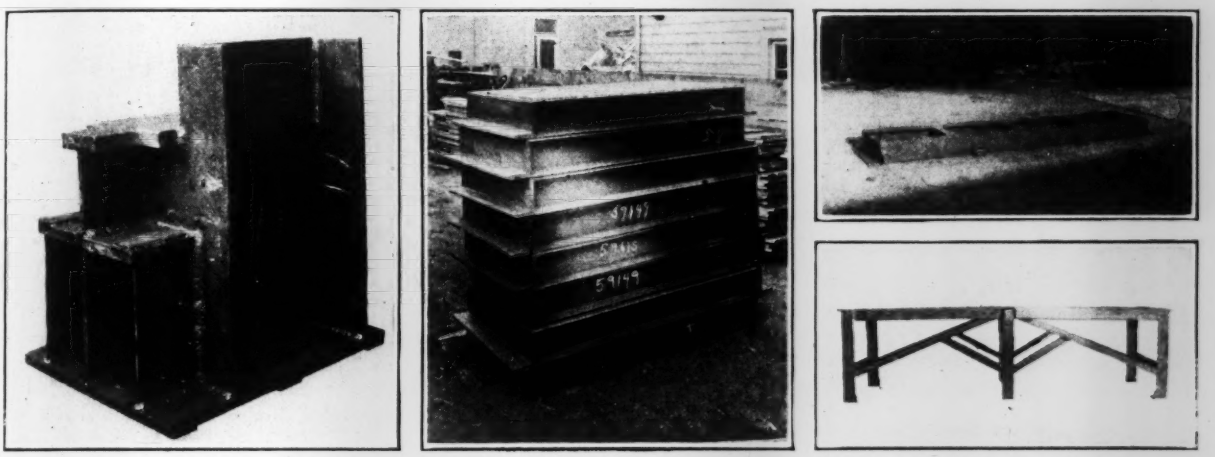
Structural steel pieces were welded together to produce the equivalents of these castings. Where standard structural shapes were not suitable, the off-standard shape was built up by welding together pieces of standard shapes and plate. The accompanying illustrations show a number of pieces made in this manner.

Practically every problem involved in the use of steel for strength members has been encountered. A great many problems have been met and solved which were far more difficult of solution than any problem ever encountered in the use of steel for building purposes. It is purely incidental to the matter under discussion but nevertheless interesting that the use of welding enabled us to dispense with 85 per cent of the tonnage of gray-iron castings we had formerly used, and that the saving so effected averaged well above 50 per cent.

Up to the present about 15,000 tons of steel have been fabricated in our plant entirely by welding in accordance with this plan. Other manufacturers with our cooperation have done probably twice as much welded fabrication to replace gray-iron castings, and we have the essential facts of their experience as well as our own. Results developed from this experience are:

(1) The metallurgical limitations of welding must be taken into consideration in the design of a welded joint.

(2) Joints must be designed for welding; adaptation of welding to riveted design is not satisfactory from the cost point of view.



WELDED STRUCTURAL STEEL MACHINE PARTS; MADE AT SAVING OF MATERIAL AND LABOR

Left—Machine base replacing a casting; the casting would have cost six times as much as the welded steel base. Center —A group of machine bases made of angles, channels and plates. Right—A large welded base, and a shop table frame.

(3) We have not had a weld fail which was designed by our engineering department and made under our own supervision.

(4) The average cost of the welding per ton of steel was under $20 per ton, this figure including the assembling and welding labor, electric power and welding rod.

5. The material saved as compared with riveting averages about 20 per cent.

(6) No saving has been made in supervision and inspection; the work must be done by high-grade men under competent supervision.

(7) A considerable part of the work has been done on piecework rates, with advantage from the cost point of view and entirely safe.

The extent to which these facts apply to the welding of structural steel for buildings may be subject to some difference of opinion. The object was not to prove that welding should be used in place of riveting in building construction, but rather to develop facts. However, it may be of interest to state our own conclusions.

Based on the experience of turning out some 45,000 tons of steel fabricated entirely by welding, we conclude:

(1) Welding structural steel for buildings may be done safely in the shop under proper engineering design, competent supervision and competent inspection.

(2) Under shop conditions there is a possibility of saving about half the labor required for riveting in many cases; on some classes of work there would be no labor saved. No estimate can be made at this time on what the average labor saving would amount to for any given period due to the wide variation in the nature of the work.

(3) The material saving will depend entirely on partic-

ular circumstances, and no general estimate can be made. It appears reasonable to assume that material savings can be made, perhaps of the same order as those actually made in the work described (20 per cent).

(4) The economy of field welding in the erection of building structures is open to question at the present time except where noise elimination is a determining factor. Further developments may be expected, showing the economy of welding.

(5) The economy of field welding in the repair or alteration of existing steel structures or buildings is certain. Very large labor economies may be shown in this direction.

In view of the conclusions stated above, it is apparent that the application of electric arc welding to the fabrication of steel for buildings has been carried about as far as the manufacturers of welding equipment can carry it. Welding has been shown to be safe and economical in many cases. The opportunity is at hand for large steel fabricating organizations to turn this experience into working practice.

Steel Railroad Bridge Raised 21 Ft. Under Traffic

Reservoir Necessitates Union Pacific Line Change —Raised Spans Rested on Concrete Blocks While New Concrete Sets

THE construction of a 1,700,000 acre-ft. reservoir on the Snake River for the American Falls project by the U. S. Bureau of Reclamation necessitated the reconstruction of about 2½ miles of main line on the Union Pacific R.R. and the relocation of station facilities at the village of American Falls, Idaho. Grade reduction work undertaken by the railroad company in connection with this project required that the single-track railroad bridge across the Snake River be raised a total of 21 ft. 4 in. This was accomplished without interruption to traffic, by jacking up the spans, a little at a time, and supporting them on precast concrete blocks while concrete poured around the blocks raised the tops of the piers a corresponding amount.

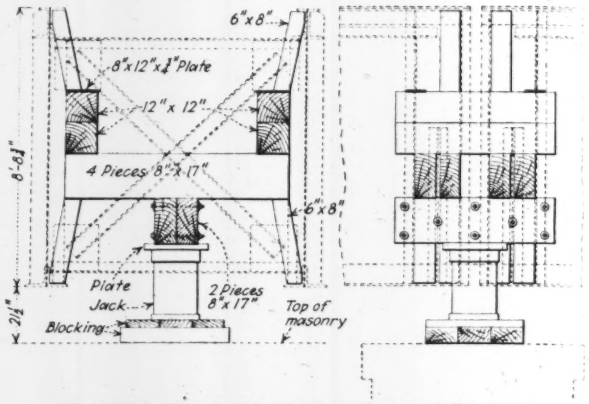
The length of the bridge before raising was about 890 ft., made up of nine deck plate girders of lengths ranging from 18 to 85 ft., and one 250-ft. pin-connected deck Pratt truss. The weight of the truss span is about 680 tons. In the elevated position and in order to conform to the line change it was necessary to add two additional girder spans, one 50 ft. and one 40 ft. in length, and eliminate one 18-ft. girder, thus bringing the total length of the bridge up to 962 ft. Prior to being placed in their position on the bridge the two new 40-ft. girders were used as jacking girders for raising the 250-ft. truss.

Before the work of raising the bridge could be begun it was necessary to widen and enlarge the original piers to permit extending them to the increased height. Two of the piers to be enlarged were located in the forebay of the Idaho Power Co.'s dam in about 16 ft. of water; the others were on practically dry ground below the power dam.

Excavation for the two piers in the forebay was carried on in open 40x60-ft. cofferdams that had a 13-ft. earth core faced inside and outside with Wakefield sheetpiling. About 2,200 cu.yd. of earth was puddled into each of these cores, being delivered by bottom-dump cars through the deck of the bridge into chutes which conveyed it into place in the cofferdam. Although the cofferdams rested on lava rock they satisfactorily kept out the water during the entire period of excavation and the placing of concrete.

Before enlarging the piers, all faces were chipped to provide clean, rough surfaces for bonding with the new concrete. Concrete was then poured up to the level of the original pier tops while the bridge still remained in its original position.

The transportation of concrete and other material was accomplished with the aid of temporary outriggers on the deck of the bridge, on which two standard-gage tracks were laid. These tracks were operated by motor-



FRAMING THAT ENABLED ONE JACK TO LIFT ENDS OF TWO SPANS

driven endless haulage cables, ¾ in. in diameter, running over pulleys and drums. A tension carriage with counterweights was provided to keep the cable line tight at all times. The speed of this system under load was between 3 and 4 miles per hour. A concrete mixing plant installed on the east bank of the river delivered concrete by means of a tower and chute to cars on these outrigger tracks which delivered directly to each pier.

The actual raising of the bridge was accomplished by hydraulic jacks, operated by a steam pump developing a pressure of 6,000 lb. per sq.in. Operation of the pump was controlled by a buzzer signal from the piers so that the foreman could accurately control the raising. Precast reinforced-concrete blocks, 8x8 in. in section, were placed under the bridge shoes as the raising progressed to serve as temporary support. After a grillage of these concrete blocks had been built up 32 in. high, forms were built up around the pier and concrete was poured to the top of the grillage, encasing the concrete blocks as a part of the finished structure. A total of 4,000 of these precast concrete blocks of various lengths was used in raising the bridge and 6,000 cu.yd. of additional concrete was placed in the piers.

In raising the piers, before each pour was made the top of the previous pour was well sluiced off and chipped with picks. The temperature rods near the outer face which were the only reinforcing in the piers, were left projecting from unfinished pours to aid in bonding. The ¾-in. transverse rods showing in one of the pictures are tie rods for the forms. These were made heavy because of the absence of outside shoring.

Plank cushions were placed between the bridge shoes and the concrete blocks to prevent cracking caused by point bearings due to minor defects on the block surfaces. The small spaces between the precast blocks were filled by forcing grout into them as the concrete was poured.

The raising was carried on progressively from one end of the bridge to the other, the concrete gang following closely behind the packing gang. A complete cycle of raising required from 7 to 8 days. By the use of timber shoring to transmit the load of the girders to the jacks, only one 100-ton hydraulic jack was needed on each of the piers under the girder spans.

bridge and as the raising progressed the track on this runoff was kept up to grade by means of earth and gravel placed with ballast cars, unloader and spreader. By the time the raising had reached a height of 16 ft above the original grade, the construction of the new line change had been completed and connection was made to the new line so that from this point on traffic

Raising Snake River Bridge at American Falls, Idaho

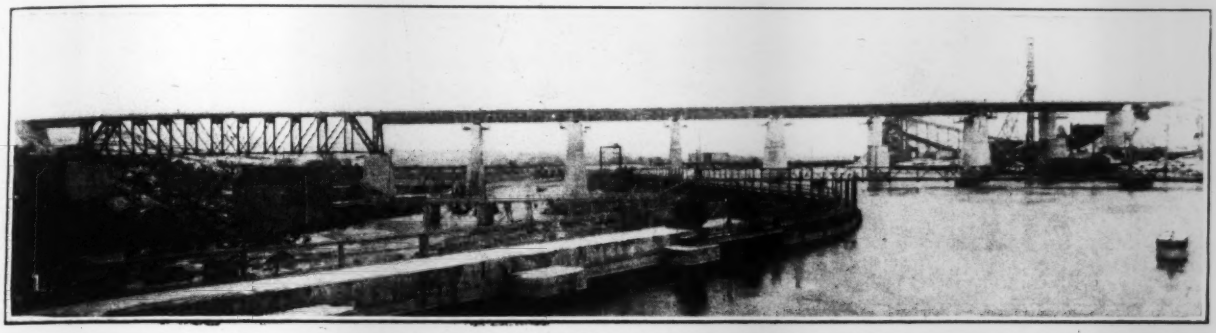


FIG. 1—SNAKE RIVER BRIDGE AFTER IT WAS RAISED
Note that alternate piers were enlarged, while others were simply raised. Concreting tower is shown at right; also the working platforms are still in place.

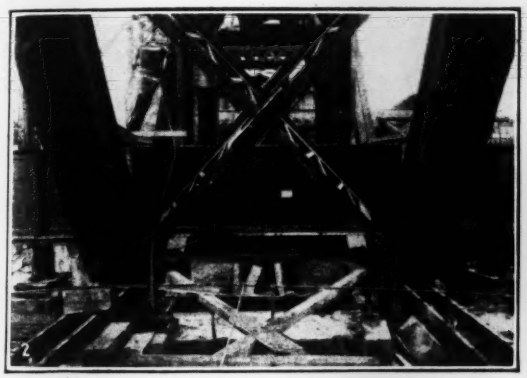


FIG. 2—JACKING GIRDER IN PLACE AT END OF 250-FT. SPAN
Jack at left is blocked, ready for raising; jack at right is held against bottom flange of jacking girder by counter-weights.

FIG 3—STRAP FROM SHOE PIN PASSING OVER THE JACKING GIRDER
Strap is 1x11 in.

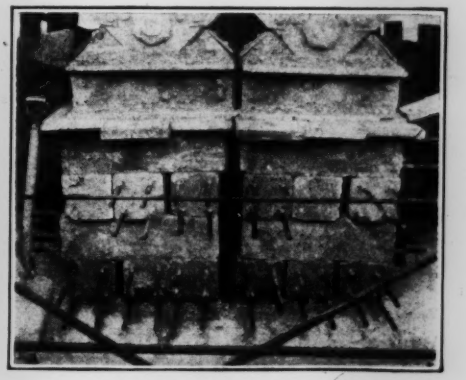


FIG. 4—PRECAST BLOCKS SUPPORTING SHOE BEFORE CONCRETING ABOVE PIER
Forms ready for concrete that will raise top of pier.

The raising of the 250-ft. truss, on the other hand, required four 300-ton jacks, two under each end. The truss span was suspended from the two plate girders, already referred to, by means of 1x11-in. steel straps passing around the ends of the pins at L_0 and over suitable bearing castings on the girders. The girders in turn bore directly on oak cushion blocks on the jack heads.

The bases of all the jacks were counterweighted by means of cables passing over sheaves to sand boxes. Thus when the pressure was released and the blocking was removed from beneath, the jack would be kept in position for the next lift. By keeping the jacks pressed against the under side of the jacking girders in this way much handling of jacks was eliminated.

In order to safeguard the men and to provide them with ample room around the piers during construction, working platforms were suspended from the several spans at a height suited to the progress of the work. These platforms were 3 ft. wide, extended entirely around the pier, and were provided with hand rail and toe board.

A 1,200-ft. runoff was maintained at each end of the used the new location. During the work there were four regular passenger trains and a maximum of 14 freight trains besides helper and work trains moving over the bridge during the 8-hr. working period.

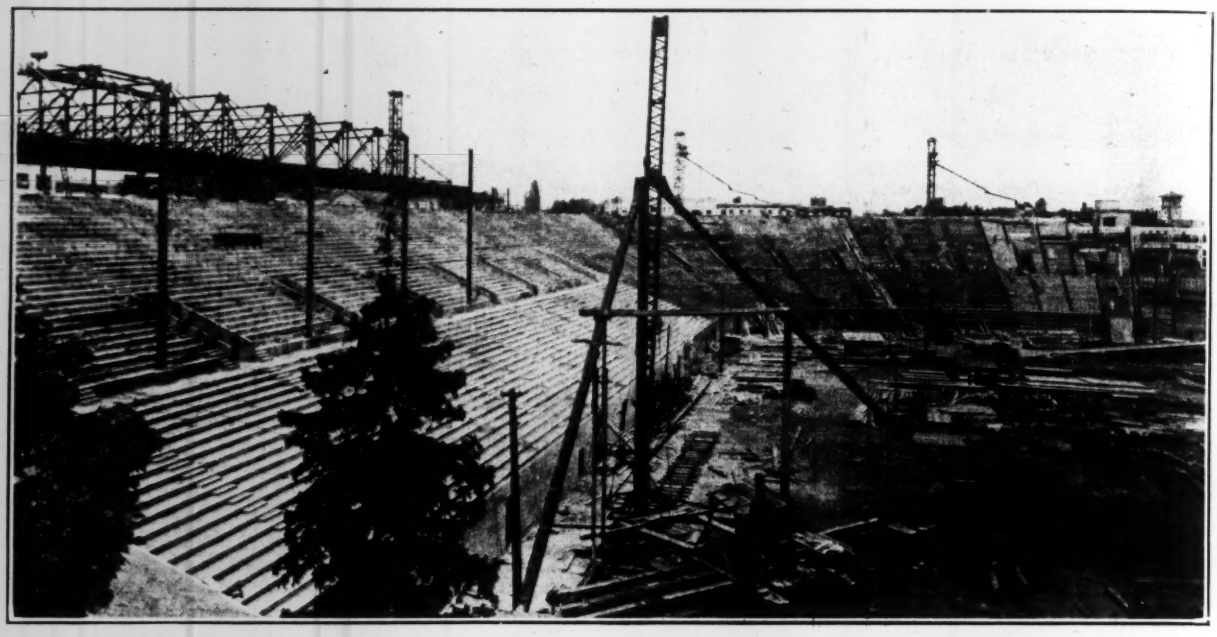
Work on this project commenced March 12, 1925, when the railroad crews began building camp and unloading materials and equipment. The actual raising of the bridge commenced Oct. 15, 1925; traffic was diverted to the relocated line on Dec. 7, and the final lift was made on the bridge Dec. 15, 1925. The work as a whole involved an expenditure of $567,952 of which $189,554 was for raising and extending the bridge while the remaining $378,398 was for the line change.

The project was carried out by R. C. Williams, assistant to the system bridge engineer; D. S. Meadows, bridge engineer of the Oregon Short Line R.R.; and L. W. Ashton, construction engineer, according to plans prepared by W. R. Armstrong, assistant chief engineer; and G. H. Trout, system bridge engineer, working with Messrs. Williams and Meadows, and approved by R. L. Huntley, chief enginere of the Union Pacific System and E. E. Adams, assistant to the president.

Rush Construction Job on Portland Stadium

Concrete Structure with Present Seating Capacity of 30,000 Built in 5 Months—Several Operations Done Simultaneously—Large Panel Forms Used Extensively

FUNDS were raised by popular subscription and bond issue this year in Portland, Ore., for construction of the Multnomah Field civic stadium located on Multnomah Athletic Club property close to the business district of the city. The contract was let on May 10 and in accordance with the contractor's agreement the stadium was ready for the Washington-Oregon game on Oct. 9. To meet this 5-months' construction schedule very careful attention was given in advance to plant layout and to the sequence of construction operations so as to avoid interference wherever possible. The job was operated on a 2- or a 3-shift schedule when this was consistent and in building up concrete forms large panels were used extensively. Throughout the construction period a feature of the job was the presence of an unusually large number of workmen; to meet the high speed construction schedule required a heavy percentage of labor cost.



SIMULTANEOUS OPERATIONS: FRAMEWORK AT RIGHT, CONCRETING IN CENTER, STEELWORK AT LEFT
Concrete pours completed in portion at left. Note arrangement for advancing steel derrick in foreground.

The design of the stadium called for a single-deck concrete structure with a wooden roof supported on steel columns. For the present the structure has been extended around only two-thirds of the horseshoe that will be formed by the stadium as ultimately completed. In that portion just finished there are 24,000 seats under cover and 10,000 bleacher seats. When the final third of the single-deck structure is added the seating capacity will be raised to 50,000.

Because of the danger of rainy weather in this city during the football season it was considered necessary to provide a roof. The stadium was therefore covered with a 10-year composition roof supported on steel columns. The straight portion is designed for a second story that can be put on at some later date. In fact, the steel columns may simply be cut off at the level of the top row of seats in the first tier and raised when the second tier is added.

The location is at the Multnomah Club athletic field where an old creek bed makes it possible to support two sides of the structure on natural ground slopes while under the third or curved portion is a fill, 10 or 15 years old. On this fill the concrete structure is supported on columns that go down through filled ground to a foundation of the same hard clay that supports the sides. This location without the use of any fills is expected to reduce to a minimum any cracking in the concrete due to settlement.

In laying out the construction program the plan followed was to work backward from the Oct. 9 date of completion. A time limit was therefore set on each operation and a chart was made showing in detail the necessary progress, week by week. Throughout the job there was strict adherence to the construction schedule as programed in advance and the finishing touches were put on the job a few hours before the time set for final completion.

One of the notable features of the rush schedule was the use of the athletic field within the stadium for making up concrete forms in units or panels. Each of these panels had been detailed by a draftsman just as though it was to be made of steel. Thus the car-

CONCRETE FORM ERECTION UNDER WAY, PORTLAND STADIUM
Panels built up in athletic field at left. Note crews of men at right delivering panels

penters had working drawings and they worked to good advantage on level ground where there was no interference with other operations or delay due to cutting and fitting while standing on falsework. Each panel was marked to indicate its place in the forms and when it was needed it was picked up by a crew of men and by means of inclined runways from the field, was "rushed" right to its proper place.

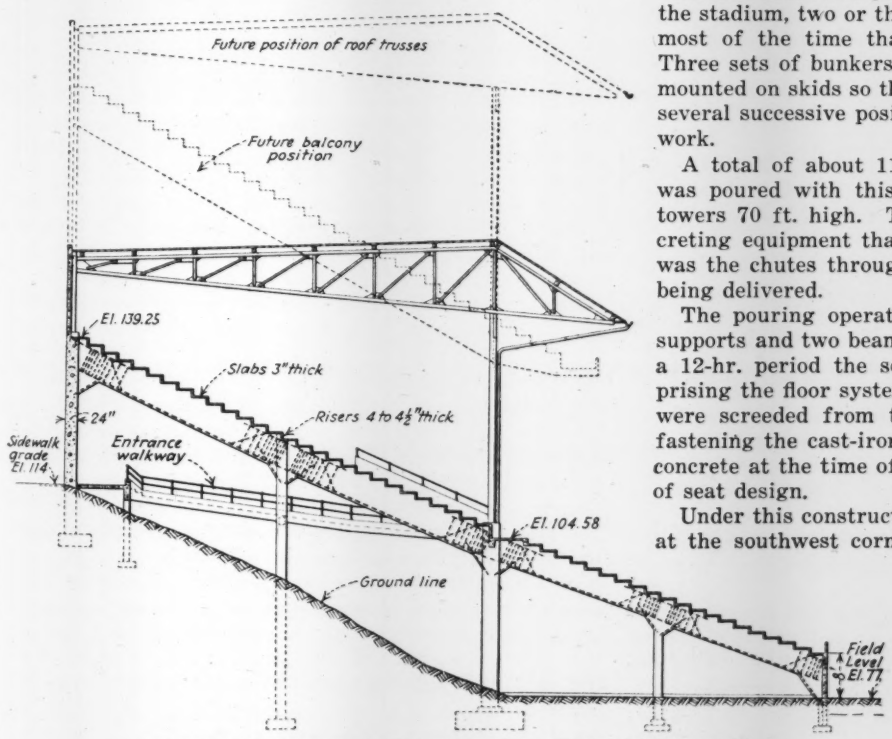
Panels handled in this way were quickly fastened in place, the work being done in much less time than would have been required to assemble the entire forms in place. Some panels were as long as 40 ft. with a height of 6 ft. and as many as ten men were used to handle them.

Another factor in the non-interference of several simultaneous operations was the placing of all concrete mixing equipment, materials storage and concrete towers outside the stadium instead of using one central mixing plant with a tall tower and distribution chutes to all parts of the work. Concrete was mixed and delivered from five points around the outer curve of the stadium, two or three of which were in operation most of the time that concreting was under way. Three sets of bunkers were provided and these were mounted on skids so they could be moved along to the several successive positions they occupied during the work.

A total of about 11,000 cu.yd. of 1:2:4 concrete was poured with this equipment from five chuting towers 70 ft. high. Thus the only part of the concreting equipment that extended within the stadium was the chutes through which concrete was actually being delivered.

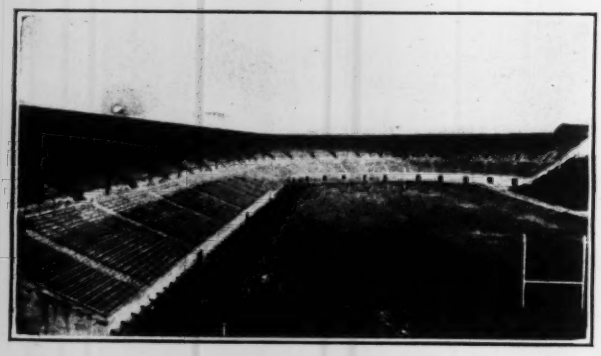
The pouring operations included first the column supports and two beams for a section of seats. After a 12-hr. period the second pouring operation, comprising the floor system, was begun. The floor slabs were screeded from the top downward. Bolts for fastening the cast-iron seat supports were set in the concrete at the time of pouring as seen in the sketch of seat design.

Under this construction program work was started at the southwest corner of the job and after work was well under way there were four independent operations under way simultaneously; excavation for foundations was in the lead, of course, and close behind came the form carpenters, then the concreting crews



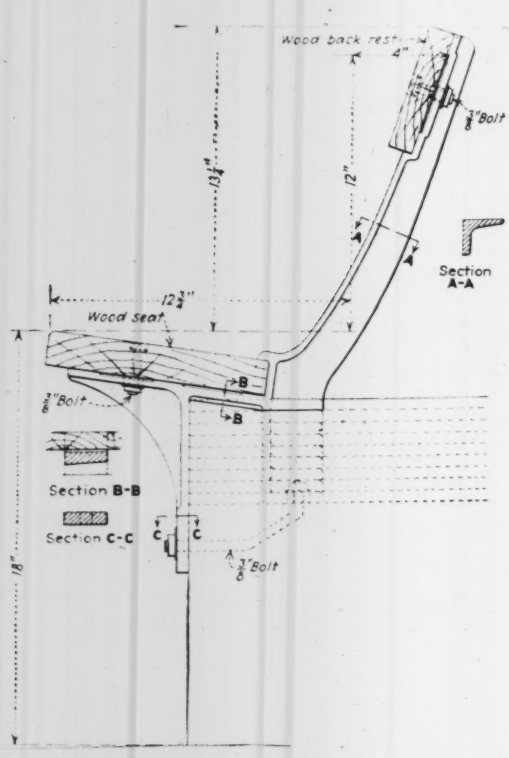
SECTION SHOWING MAIN FEATURES OF STADIUM SEATS

and finally the steel superstructure was being erected from a derrick that moved around the field as the work progressed. This derrick had a 120-ft. boom to which



STADIUM COMPLETED, A WEEK BEFORE THE GAME
Portion to be added later will consist of another straight section at the right.

the addition of a 30-ft extension gave a 150-ft. reach. Being mounted on a track of about 40-ft. gage made it possible to move this derrick quickly and conveniently as the work advanced. As there was no occasion for the



DETAILS ADOPTED FOR STADIUM SEATS

derrick to return to completed work the track was laid only in short sections immediately adjoining the point where work was in progress.

The accompanying sketches show the present structure with plan for adding a balcony and for raising the present roof when that is done, also the design and method of placing of the present seating system.

The general contractor on this job was The Hansen-Hammond Co., Portland, Ore.

Writing a New Building Code

How New Orleans Handled the Problem with Aid of Engineering Societies—Pile Foundation and Wind Pressure Provisions

By F. A. Muth
First Assistant Superintendent, U. S. Lighthouse Service, New Orleans, La.

NEW ORLEANS has a new building code. It replaces the former code of 1910 and is not a revised or amended document but a wholly new document. The story of how it was brought into being is of interest not only because of the method followed but also because of the fact that it is based on principles of modern practice and is so arranged as to be readily amended.

The Louisiana Engineering Society for several years has been advocating a new building code for the city, and in the spring of 1924, with the aid of the Contractors and Dealers Exchange, an appropriation by the city was secured for the employment of some one to codify the building laws.

Organizations of business and professional men offered their services, and representatives of these organizations were accepted by the city engineer to form an advisory committee. This committee was headed by Col. Marcel Garsaud, general manager of the Board of Commissioners, Port of New Orleans; he represented the Association of Commerce as well as the Contractors and Dealers Exchange. Each of the other members of the committee was the chairman of a sub-committee made up of specialists in various professional lines, representing the following organizations: General Contractors Association, American Institute of Architects, Louisiana Engineering Society, Louisiana Fire Prevention Bureau, New Orleans Homestead League and Real Estate Association, and Louisiana Bar Association. These sub-committees had from two to twenty members, and included a total of 58 men, all selected with a view to their ability to assist in the preparation of the code.

Upon a recommendation of the advisory committee and the city engineer, the writer was employed as technical expert after being granted leave from government service. He prepared digests of the building codes of progressive cities in all sections of the country together with a digest of the old building code, which formed the basis for drawing up a skeleton outline of the new code. After this outline was adopted, the recommendations of the various sub-committees were received, together with suggestions from interested citizens and from numerous national organizations and government bureaus. The suggestions, when codified, were acted on by the appropriate committees, and were then printed in tentative form, which was held for suggestions and criticisms for a period of over a year. Especial benefit was derived from suggestions by both local architectural associations. The advisory committee then prepared the final draft of the code, and subsequently recommended it to the Commission Council. The latter on Oct. 19, 1926, adopted it by ordinance.

Standard Specifications Used—While the committees at all times bore in mind that safety is an important element in any type of construction, great concern was given to cost and economy in the building laws. To this end, building codes of other cities were considered, though not followed except when suited to the local requirements. The work of the U. S. Department

of Commerce in standardization was kept in mind and it was found that the work of the building code committee of that department was most helpful. Quality requirements of masons' and other materials were based on the specifications and tests of the American Society for Testing Materials.

In order to simplify future modernization, the following were adopted as standards in the code: for concrete construction, the recommendations of the Joint Committee on Standard Specifications for Concrete and Reinforced Concrete (1924); for steel, the specifications of the American Institute of Steel Construction (1923); for stresses in timber, the basic grading rules and working stresses for structural timbers of the U. S. Forest Service (Forest Products Circular 295, 1923). These standards were considered to represent the best present requirements and practice, but to prevent the code from becoming obsolete it is provided that subsequent issues of these standards may be adopted by publication of notice in the city's official journal.

Local Problems; Piles—Certain engineering features were considered as a local problem, and existing codes of other cities were not employed as criteria or standards. For instance, the *Engineering News* pile formula is conspicuous by its absence. Due to the peculiar soil conditions in this locality the following paragraphs were adopted to cover the driving of piles:

> No part of the load carried from the footings to the piles shall be figured on the soil surrounding the pile.
>
> The city engineer shall be satisfied as to the sufficiency of the sustaining power of all piles. The city engineer may require test piles to be driven at the expense of the owner to determine the length and safe supporting power of piles for the structure.
>
> Should test piles be required by the city engineer, the number of said test piles, the manner of driving same, the records of borings, etc., shall be such as to meet the approval of the city engineer.
>
> Should the city engineer so require, the said test piles must be tested with known loads at the expense of the owner, and the method of applying the test loads and of making and recording observations on the loaded test piles shall be such as to meet the approval of the city engineer.
>
> Certified copies of records of driving test piles, of loading same and of observation on the loaded test piles shall be furnished the city engineer.
>
> The allowable working loads on a wooden pile or on a concrete pile shall be in no case more than one-half of the load which can be sustained for 48 hours with 0.01 in. per ton of load applied, and no observable settlement in the succeeding 48 hours.
>
> The city engineer shall be notified of the time when the test piles will be driven and loaded. In the absence of the city engineer or his representative the driving of test piles may proceed, provided reasonable notice has been given.

Wind Bracing—The matter of wind pressure and wind bracing requirements is covered by specifying 25 lb. per sq.ft. normal to the wind (reduced by Duchemin's formula for inclined surfaces), and 0.6 as much on cylindrical surfaces. Stresses due to wind combined with load may exceed the otherwise allowable stresses by one-third. Anchorage is required when the overturning moment exceeds half the moment of stability.

As to wall resistance the following is specified:

> The resistance offered to the distortion of a framed structure by spandrel walls and partitions shall not be counted upon, but said distortion shall be provided for by properly designed bracing.

The engineering committee after careful consideration of the requirements of this locality arrived at the value of 25 lb. for the wind pressure. This, however, was based on the frame of the structures carrying the wind load without any reliance being placed on the stiffening or bracing effect of the spandrel walls or partitions. Furthermore, the enforcement of the requirements of the new code is premised upon an increased organization in the Building Department with an adequate force of structural engineers for checking plans and of more inspectors in the field.

Designer Must Be Licensed—In line with the growing tendency in other parts of the country to safeguard the public, further requirements in the checking of drawings were insisted upon. The importance of the qualified architect and engineer is recognized in the following requirements for the signing of drawings to secure the building permits:

> All plans involving structural design of sufficient importance, in the opinion of the city engineer, shall be signed by an engineer or an architect registered under the laws of the State of Louisiana; said engineer or architect to be qualified for structural design.

As already mentioned, Col. Marcel Garsaud was chairman of the advisory committee. Prof. Donald Derickson was chairman of the engineering committee. John Klorer, who was city engineer when work on the code was commenced, later was elected commissioner of public property, and by nature of his engineering training, was able to appreciate the engineering importance of the new building laws.

Test to Determine Rivet Stagger

New tests to determine rivet stagger were made recently by Prof. C. R. Young and W. B. Dunbar, at the University of Toronto, and are reported in Bulletin 6 of that institution, just issued, under the title "Net Sections of Drilled Plates." Tension tests of thin rubber strips with four staggered holes, in which the progressive stretch of different parts of the strips was measured, did not lead to any conclusions, as the strains seemed to be quite uniform. Subsequent tests were therefore made with steel plates $3\frac{1}{2}$x$\frac{3}{8}$ in. and $5\frac{1}{2}$x$\frac{3}{8}$ in. with two or three holes, at various staggers; 36 of these plates were tested to rupture. In some specimens the holes were plugged with tight-fitting cylinders, but this had no appreciable effect either on the location of the failure or on the ultimate strength. The ultimate strengths of the several specimens are not given in the report but the location of the failure is described. All the specimens having such stagger that the diagonal and transverse net areas were equal failed on the diagonal or zigzag sections. Those so proportioned as to have about 5 per cent greater diagonal than transverse net area failed indifferently in either direction. With stagger proportioned by a previous rule derived by Professor Young, the failure was preferentially on the transverse line, indicating that the stagger allowance was in excess. The authors present their final recommendations for stagger by a series of diagrams, and propose as a simplification, for use when the diagrams are not at hand, a rule proposed by D. B. Steinman, according to which the rivet-hole deduction for the second hole is

$$x = 1.30 - s/g,$$

where s is the stagger, g is the gage, and the deduction x in no case exceeds unity.

Reinforced Concrete—Its Shortcomings as a Material

In Militant Review Professor Swain Concludes That Concrete Is Variable, Undependable, Changing During Its Life, and Non-permanent—Paper and Discussion Summarized

LAST week Prof. George F. Swain, of Harvard University, addressed the Boston Society of Civil Engineers on the subject, "Why I Prefer Steel to Reinforced Concrete." The address was a detailed review of those features of concrete and its behavior that have given trouble or have been subjected to special study. It constituted a large-scale indictment of concrete. Structural steel (and to some extent other building materials) were described as preferable to concrete and reinforced concrete in a great many uses where concrete has come to occupy a distinct place in the construction art. The paper was, with slight change, identical with one read by Professor Swain before the organization of the steel fabricators, the American Institute of Steel Construction, at its annual convention two months ago, under the title "Steel for Strength and Security," as reported in *Engineering News-Record* of Nov. 4, p. 739. At that convention the paper was not discussed. The Boston meeting, however, at which 250 to 300 engineers gathered, entered into very active discussion of Professor Swain's paper, in which discussion he was almost unanimously opposed.

A greatly condensed version of the paper follows, together with notes of the Boston discussion. References and citations, which form a large part of the original, are of necessity here omitted, but the general course of the argument is reproduced.

At the outset the author named as main virtues of a structural material economy, durability and strength, and further listed under strength such qualities as toughness, constancy, and high tensile strength, which latter he considers desirable even in a compression material. On the basis of this outline, he referred very briefly to the particular excellences of wood, of stone, and of burnt clay products, and more at length to those of steel. With this preparation, he plunged into his critical review of concrete, of which what follows is exact quotation though much of the text is necessarily omitted.

* * *

The first peculiarity of concrete to be noted is that it is not a finished product. It is made on the job. The engineer must not only design the structure but he must design the material. The constituents, stone, sand, cement, and water, are each subject to defects that must be guarded against, and they are extremely variable. The stone and sand must be graded properly in size, and mixed in proper proportions with the cement and water; and this must be done, not in the laboratory or factory, but on the job, with all the necessary uncertainties, and often with very unskilled labor. The material is not finished until it is in the structure, and then it cannot be tested or rejected.

Another most important characteristic of concrete is that it changes after it is placed beyond recall in the structure. In this respect it differs radically from all other structural materials. The real manufacture of the material begins then, when it begins to set and harden. The phenomena of setting and hardening are not fully understood. It seems to be partly a crystallization, but mainly the hardening of a colloidal mass composed of cement particles which absorb water and swell, the water gradually penetrating into the particles.

All concrete, unless waterproofed, is more or less porous, and will swell and shrink when wetted and dried, and with varying moisture in the atmosphere. Further, a large part of the cement in concrete is soluble in water, and can be dissolved out or can form other compounds with acids in the water.

Variability—Consider the situation for a moment. Concrete is a material made on the job, dependent upon the quality of stone, sand, cement, and water, the proportions, the care in mixing and placing, and much influenced by small variations in the quantity of water used. It sets after being placed beyond recall. Its ultimate condition depends much upon the curing, or treatment during setting, and the amount of water given it. It expands and contracts subsequently as it is wetted and dried. Is it not obvious that there must be considerable uncertainty in the resulting product? Modern methods of field control have made it easier to secure uniformity and good quality, but great lack of uniformity still exists. If a pint of water in a batch makes so much difference, how can we expect uniformity with ordinary workmen, varying weather and varying moisture in the materials? What would be thought of steel if the ingredients, iron and carbon, or ferrite, cementite, and amorphous material had to be selected from widely varying materials, mixed in the field, put into the structure when molten, and allowed to harden there? How much better and more reliable than concrete is a material like steel, which comes to us a finished product that can be tested, which suffers no change of constitution when put in the structure, which is not porous and cannot have its constituents washed out, and is only subject to surface oxidation, which can be prevented!

Volume Change—The strength of concrete varies with the temperature and with the degree of saturation. . . . But this is not all. Setting in water, reinforced concrete expands, causing tension in the steel and compression in the concrete. Setting in air, it contracts, causing compression in the steel and tension in the concrete. Professor White [Alfred H. White, professor of chemical engineering, University of Michigan] says that "these volume changes, which seem due to a fundamental property of portland cement, are the most potent causes of the destruction of concrete exposed to the weather. If concrete is to be kept constant in volume, its moisture content must be held relatively constant," and this cannot be done unless it is waterproofed and all water prevented from entering, and in this case complete hydration will probably be prevented.

The expansion of 1:2:4 concrete in water may amount to 0.01 per cent in 120 days, and the contraction

in air to 0.05 per cent or more. This means that a bar 100 ft. long may contract 0.6 in. . . . In a 10x10-in. bar 10 ft. long with one ¾-in. rod, the bond stress may be 130 lb. due to shrinkage. . . . There is no doubt of the seriousness of these stresses. In columns, the shrinkage stresses may exceed those allowed in the design, while in beams the tension reinforcement will be relieved but the concrete tension increased. These stresses have generally been entirely ignored because they were not known.

Theory—Turning now to the usual methods of computing reinforced-concrete structures, the situation is also uncertain and unsatisfactory. . . . As a matter of fact, nobody knows how a reinforced-concrete beam acts. It probably acts partly as a beam, partly as an arch, partly (if rods are bent up at the ends) as a catenary or suspension system, and nobody knows to what extent in each way. And I have always wondered just what bond there is in a reinforced-concrete beam after it has been in use for some months or years, and exposed to a series of alternate wettings and dryings, with accompanying shrinking and swelling. . . . The bond is certainly not distributed as the usual theory assumes, and the stress in the steel at a point where the moment is not a maximum may, if there is truss action, be greater than computed. The bond may not act in the same direction at all points of a bar, and suddenly increases where a bar is cut off. I am forced to the conclusion that the theory of reinforced concrete is still almost wholly empirical. We know little about it except that certain beams have carried certain loads in laboratory tests.

Further, it is to be observed that before a beam can act according to the usual theory, with the rods stressed to say 16,000 lb., the concrete must crack. This is the only structure composed of two materials in which the accepted theory presupposes the actual rupture of one of the materials. This certainly does not look very good.

Consider now the concrete column reinforced by longitudinal rods. The shrinkage of the concrete due to varying moisture will, as we have seen, produce initial compression in the rods, which may be large. Now these slender rods, if standing alone and subjected to the loads that they are assumed to carry, would bend laterally. They would not carry those loads. They are only prevented from bending by the surrounding concrete. But they tend to bend all the time, and so tend to split off the surrounding concrete unless all the rods tend to bend toward the center of the column, which cannot be assumed. Here, then, we have a compound material in which one material tends, by its own action, to make the other fail, and does make the other fail, at the ultimate load.

Concrete has to some extent a flow or plasticity under stress. . . . This is in some respects a favorable quality, as it indicates that a concrete structure, if watched and measured, should give warning of impending failure. But it is surely most undesirable to have a continuing flow take place under comparatively small loads, or those used in the design.

. . . Strength for strength, concrete weighs about seven times as much as steel. On this basis, then, does it not appear that in using concrete we are loading our structures, and especially their foundations, with great loads of sand and stone which only contribute weight and not strength?

Permanence—No material, probably, is permanent under all conditions. There are always destructive agencies that may destroy it. Steel and iron are, as we all recognize, subject to rust, which is merely surface oxidation, and which may be prevented if care is taken. There is no internal change, no dissolving out of any ingredient. Concrete is very different. Practically all concrete is porous. The cement may be dissolved out. The concrete in reinforced-concrete beams is assumed to crack if subjected to the assumed loads. Freezing and thawing may disintegrate it. The effect of salt or alkali earth is very harmful. Indeed, concrete corrodes, as steel does, but in a more harmful way. Concrete will be permanent under favorable conditions. But conditions necessary for permanence seldom or never exist. A great deal of concrete work has been built. Some of it has lasted well but a great deal has disintegrated and is going to pieces, and there have been many failures.

That many concrete structures, which were at the time of their construction considered as perfect as they could be made, are disintegrating is being reluctantly admitted. Any one who will examine many of these structures will find abundant proof, and there have been many failures and collapses.

Various reports and papers classify the causes of defective concrete and of failures. . . . When one scans this list and considers the character of the usual workman, he may be inclined to agree with Professor White, who says: "It (concrete) has latent possibilities of harm which no other major building material possesses. Its faults are, so far as we know, necessarily inherent in the material."

Frost may be a potent cause of disintegration. If there is no liquid water in the pores, it may be frozen without harm, but if there is liquid water, it will expand; but if a hair crack develops, water may enter and cause progressive disintegration. Even hair cracks must be prevented if disintegration is to be avoided when concrete is exposed in the open air in conditions where ice may form.

Corrosion of the steel has been a frequent source of trouble. It is said that concrete protects steel from corrosion. So it may, as long as it surrounds the steel. But when cracks develop, as contemplated by the accepted theory, water may gain access to the steel, which then cannot be protected. Especially if the water contains salts, the danger may be great. . . . Trade wastes, depending upon their character, may cause disintegration. Sewage may do the same, and many concrete sewers are showing poor results.

It is possible to get a good original job, but there still remain the stresses and cracks due to changes of moisture and the action of the loads, and the time effect, which defects are inherent in the material and preclude the possibility of predicting the life of a concrete structure.

Economy—One reason why concrete structures have in many cases been more economical than steel has been that the building laws have discriminated unfairly in favor of concrete and against steel. The enthusiasm for reinforced concrete has spread even to building commissions and legislatures.

For instance, the St. Louis code provides for fireproof buildings . . . [that] all exterior steel columns must have 8 in. of concrete over their outer surfaces, while

reinforced-concrete columns need have only 2 in. of concrete outside the steel! What an unfair discrimination! . . . If these unfair discriminations were removed, and if more care were exercised to get skilled labor, to select suitable materials, and to have expert supervision, there is no doubt that reinforced concrete would not work out to be more economical than steel, in many cases in which it does now work out to be more economical.

Conclusions—I would rather use burnt clay products than concrete for many purposes, as for roofing tiles and for drains or sewers, and in many cases for walls and as hollow blocks for floors.

For a structure which can be made of steel so as to be accessible for inspection and painting, I would much prefer steel to reinforced concrete. This includes railway and highway bridges, tanks and standpipes, stadia and grandstands, ships and barges, cars, etc.

How is it about structures like buildings, in which, if of steel, the metal is not everywhere accessible? Well, in such a case it is undeniable that steel is just as accessible as the reinforcing rods in reinforced concrete; in fact, more so. Therefore, I would prefer steel for buildings. I would much rather have a steel-frame building than a concrete building, especially if subject to earthquakes or hurricanes. . . . I would rather have a steel column than a reinforced-concrete column; a steel girder, protected by concrete or gunite, or haunched in concrete, than a reinforced-concrete girder. I would rather have a column footing of steel beams than of reinforced concrete.

Notwithstanding, even if my judgment is correct, there still remains a multitude of other uses for concrete and reinforced concrete, as for foundations, mass work in general, walls and abutments, piers or their backing, dams, subways, roads, etc.

Why not use each material where it is most suitable and reliable?

* * *

Discussion of Prof. Swain's Paper

Active discussion followed the reading of the paper, continuing for more than two hours until ended by the chair. Only one speaker, B. W. Guppy (bridge engineer, Boston & Maine Ry.), supported Professor Swain's condemnation of concrete.

Mr. Guppy added to Professor Swain's objections the argument that the strength of a completed concrete structure cannot be appraised when the plans have been lost, as in the case of a concrete railway trestle, which for this reason could not be rated for traffic-carrying capacity.

CHARLES R. GOW—After pointing out that enthusiastic advocates of concrete probably have overlooked the merits of rival materials, Charles R. Gow, consulting engineer, suggested that the truth probably lies between their views and those of steel advocates as represented in the paper. It is inconceivable that any structural material which has enjoyed such wide popularity as concrete should be afflicted with vital defects. Failures of concrete are not surprising, since any new art progresses by trial and error. The early years of use of structural steel will show similar failures, and with all its wealth of experience the steel art is not yet free from new experiences, as witness the failure of the Quebec bridge, mentioned by the author.

Professor Swain's paper raises the question of whether we shall abandon the use of this new and valuable material or shall continue to use it and seek to discover remedies for such faults as it may be found to have. Steel, as the author said, is excellent *if properly designed*, and similarly the troubles with concrete may be ascribed to imperfect design. But concrete is perhaps a more complex material, calling for greater care and study in working out its problems.

It remains true that concrete has filled a very valuable place in the construction activity of the world during the last quarter century. Among its advantages is ready availability, and in some uses, for instance flat-slab construction, steel could hardly take its place. It is adapted to irregular-shaped structures. It has proved very economical. It has the pre-eminent value of fire resistance, not mentioned by the author. Permanence is perhaps a relative term, but many concrete structures have stood for years with no evidence of deterioration; and if others have failed, each gave its lesson to designers as to errors to be avoided in subsequent work. As to porosity, it is believed possible today, with proper care, to produce absolutely waterproof concrete. As to strength, it is in excess of expectations; concrete is usually overdesigned.

L. J. JOHNSON—Describing himself as a warm admirer of steel and a hopeful admirer of concrete, Prof. L. J. Johnson (Harvard University) said that the development of reinforced concrete, which was essentially empirical, would not have come about if left to university-bred men. We may fairly give consideration to all the dangers and obscure points about concrete behavior and yet continue to use the material for very many uses. Fine cracks are of no meaning as to strength, and whether water will work into such cracks has to be answered by experience, which indicates that it generally does not, for the swelling due to steel corrosion would promptly reveal it. The troubles with concrete virtually all simmer down to lack of density. Too much attention has been given to 28-day strength, and the question of amount of water is best met by the rule "Workability at all hazards, and then as little water as practicable."

W. C. VOSS—Calling Professor Swain's paper a profound indictment not of concrete, but of the engineering schools of this country, Walter C. Voss (Portland Cement Association) said that the Portland Cement Association is the only national organization that has spent millions to bring to the attention of engineers not only the advantages but also the troubles of the material which it represents. Steel, he said, is subject to criticism, defects and troubles quite as much as concrete, through faults in shopwork and shortcomings of inspection, but these are not a criticism of steel. He cited the service of concrete roads, of a 45-year-old concrete sewer pipe dug up in Worcester, and similar facts as tangible evidences of the ruggedness and durability of concrete—a material which, he said, is not going to stand still or stop but will continue to progress.

L. C. WASON—Early concrete buildings (one of 1860, in Peabody, Mass., and structures in which primitive design or accident or construction defects threatened serious trouble, were cited by Leonard C. Wason (Aberthaw Co.) as demonstrating both the durability and the resistance to abuse of concrete construction. The material has greater strength than it is given credit for—can Professor Swain cite any concrete building that failed after acceptance and six months' practical use?

Long-time immersion tests as well as practical experience, give proof of the complete protection of reinforcing steel from corrosion. On the score of economy, the Attleboro standpipe—the first and largest reinforced-concrete tank, replacing an old steel structure that rusted out despite yearly inside painting—was found to be several thousand dollars cheaper than a new steel structure.

E. S. LARNED—On this same score of economy, E. S. Larned asserted that without reinforced concrete the country could not have the intense building activity of the present and recent years. Quick availability is often as important as economy, moreover; there are cases where a job waited six months for the steel to be delivered, while an adjacent job of concrete was started and finished in the meantime.

E. F. ROCKWOOD—The greater weight of concrete as compared with steel may often be an advantage, E. F. Rockwood said. Textile manufacturers have frequently stated that their concrete buildings save wear and tear on machinery and give improved operation because it is heavier and more rigid.

W. S. THOMPSON—Out of 7,500 reinforced-concrete structures that have gone through the engineering department of one reinforcing bar company in some 20 years, W. S. Thompson (Kalman Steel Co.) stated, anything approaching failure occurred in only three, and in all these cases the trouble was not with concrete as a material, but with the mishandling of concrete by designer or builder.

R. D. SNODGRASS—Early issues of *Engineering News*, R. D. Snodgrass (Truscon Steel Co.) found in a recent review, are full of reports of failures of steel structures or discussions of such failures. If a corresponding thing has occurred during the last 25 years with reinforced concrete, it merely means that any new material or type of construction goes through its period of evolution.

A. C. TOZZER—The fire-resisting quality of concrete calls for special emphasis, said A. C. Tozzer (Turner Construction Co.). In the burning of the Edison plant, 13 or 14 years ago, timber buildings were destroyed, steel members survived but were distorted out of shape, while concrete buildings were only spalled (except for mechanical injury by the collapse of a water tank) and were repaired and back in use in six weeks. Since it is imperative to fireproof a steel frame, why not use the fireproofing concrete with steel rods replacing the structural sections and save cost and time?

W. A. BRYANT—In fire and load tests of columns at the Underwriters' Laboratories some years ago, W. A. Bryant said, no single concrete column failed under its designed load in 8 hr., while steel columns required at least 4 in. of concrete protection to enable them to remain in service.

GEORGE F. SWAIN (closure)—None of the facts or arguments advanced in the paper are disturbed in the least by the discussion. If concrete buildings have stood up, it does not prove that the same buildings in steel would not have stood. The age of structural steel began only about 1890, while that of concrete goes back to 1824 (Aspdin, portland cement) or at any rate to the 50's (Monier's flower pots and boat). Even Ransome's California work antedated structural steel.

The extended use of concrete does not prove the desirability of the material; compare the popular sentiment for canals a hundred years ago, or the Canadian enthusiasm for railway construction 20 years ago, as well as the present enthusiasm in certain regions for the Chicago-to-Gulf waterway.

The paper was devoted not to characteristics of structures, but only to characteristics of the material, Professor Swain said, and he intimated that he might write another paper discussing steel and concrete in the finished structures, contrasting the shimming of columns and mismatching of rivet holes with the faults in concrete building work; and perhaps still another paper, on accepted theories of reinforced concrete and what he thinks of them.

He expressed doubt as to the practicability of producing imperivous and non-permeable concrete. He emphasized the importance of time effects in concrete, and asked whether the Portland Cement Association has published anything on this subject.

In conclusion Professor Swain expressed the belief that his paper will make people think and put a little brake on the enthusiasm with which concrete is regarded.

Safe Width of Compression Plates

Tests made for the Delaware River Bridge Commission engineers to verify the strength of the cellular elements of the steel towers of the Philadelphia-Camden bridge were carried out at the Bureau of Standards four years ago, as reported in *Engineering News-Record* of Dec. 7, 1922, p. 986. A full report on the tests appears in Technologic Paper 327 of the Bureau of Standards, by R. F. Johnston. Their interesting result is to show that the old rule, apparently originated by Fairbairn and later confirmed by Bouscaren, setting the limit for width of a compression plate (in direction at right angles to the line of stress) at 30 times the thickness, is unduly conservative. Mr. Johnston concludes that with care exercised in the selection of the plate material, the plate width may be 45 times the plate thickness, or the distance between rivet lines may be 35 times the thickness, without danger of developing buckling failure. The test specimens all were 10 ft. long and 35 in. wide, made of a single or double plate web ranging from $\frac{3}{8}$ to $1\frac{1}{2}$ in. in total thickness, four flange angles 6x4x$\frac{3}{4}$ in., and end angles with short reinforcing plates under them. Their net sectional areas ranged from 40.7 to 79.51 sq.in. The flanges were held laterally against buckling by guide girders. The failing stress of the different specimens ranged generally between 44,000 and 46,000 lb. per sq.in., two or three values going to 41,000 or 47,800; these results seemed to be unrelated to web thickness. However, webs less than $\frac{5}{8}$ in. thick developed a series of buckles at the higher loads, and much of the bulletin is devoted to an analysis of this phenomenon. Mr. Johnston finds that a formula of G. H. Bryan

$$s = 4.39\,Et^2/b^2,$$

in which s is the buckling stress, E the elastic modulus, and t and b the thickness and width of the plate, expresses the buckling strength of such plates. He also concludes that in view of the way in which buckling occurs in such webs, transverse stiffeners are of little value and if used at all should be spaced 1.4 times the width of the plate. The double-web columns were found to be just as satisfactory as columns with single-web plates of the same total thickness, although the stitch-riveting used was relatively light.

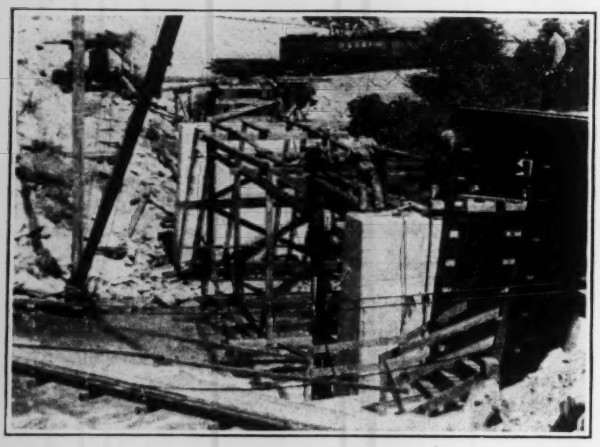
From Job and Office

HINTS THAT CUT COST AND TIME FOR THE CONTRACTOR AND ENGINEER

Bents Suspended from Abutments Form Part of Bridge Erection Falsework

By Daniel McFarland and H. C. Wood
Storrie, Calif.

In the construction of a 125-ft. steel truss railroad bridge across the Feather River, for the Feather River Power Co., Storrie, Calif., the ordinary type of falsework could not be used on account of the rocky stream bed and the swift current of the river. The distinctive feature of the procedure which was finally developed



ERECTING FALSEWORK FOR 125-FT. STEEL TRUSS SPAN

and used lay in the fact that the falsework bents for the center of the span were supported on cables suspended across the river from the abutments.

The bridge had five 25-ft. panels and accordingly four falsework bents were used. The bent next to the abutment at each end of the span was placed on a sill at the water's edge (about 20 ft. from the center line of the abutment) and then inclined so that its top would be under the first panel point. It was held in this position by cables attached to U-bolts embedded in the concrete near the top of the pier and by timber struts between the cap of the bent and the pier. Cables to support the two center bents during erection of falsework were stretched across the river and made fast to U-bolts in the lower part of each pier. One ¾-in. wire rope was used under each truss. The center bents were framed on shore, placed in their proper positions on these cables, and braced. The bracing consisted of horizontal struts between the two bents and to the inclined bents, as well as cross bracing.

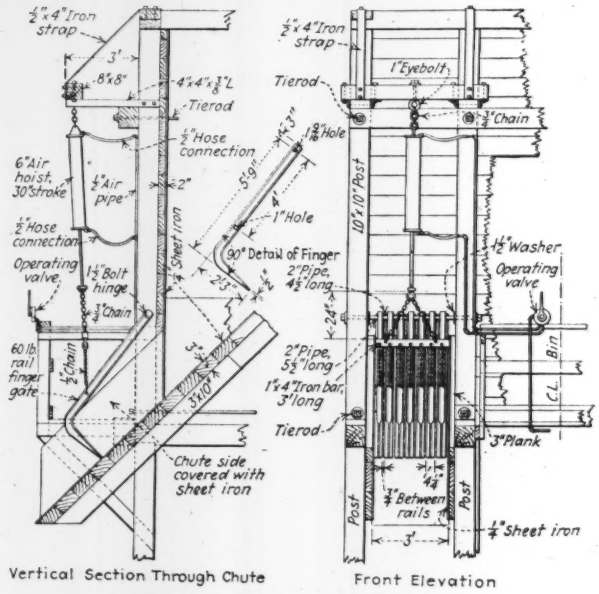
The main supporting cables for the load of the two middle bents consisted of two new 1-in. plow steel wire ropes under each bridge truss. These passed over the tops of the abutments and the inclined bents, thence under the two center bents, and were made fast to U-bolts embedded in the concrete in the rear face and near the base of each abutment. All of the U-bolts were set in the concrete at the time the piers were poured.

The steel, as well as the falsework, was placed by means of a derrick with a 135-ft. boom, located at the river's edge and about 30 ft. from the bridge center line. The falsework proved very satisfactory and no difficulties were encountered, either in its erection or removal. The erection crew consisted of 8 men, and the time required for the entire job, including the unloading, setting up, dismantling and reloading of equipment, was 26 days.

The steel was fabricated by Pacific Rolling Mill Co., San Francisco, and erected by Williams & Co., San Francisco.

Finger Gates Control Flow of Tunnel Muck from Bunkers

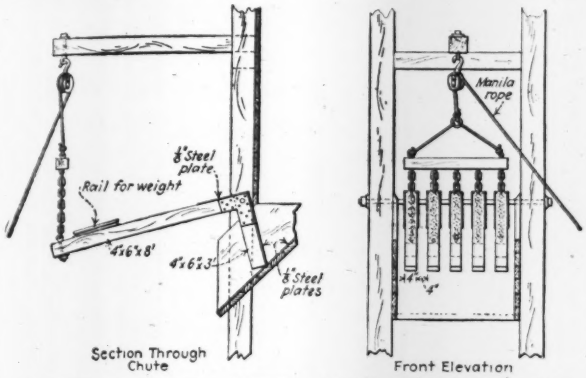
Finger gates of two types, which were made on the job, are giving satisfactory service in bunkers at the Cascade tunnel of the Great Northern Ry. in Washington. Muck from the tunnel is dumped from the small tunnel cars into these bunkers whence it is hauled away in cars of larger capacity and gage. In order to con-



METAL FINGER GATE USED AT MILL CREEK SHAFT

trol the flow of muck from the bunkers satisfactorily the gate had to be suited to handling material that varies, as tunnel muck does, from fines to rock of the largest size that will go through the mucking machines.

To meet these requirements a finger gate for the Mill Creek shaft bunker was made of 60-lb. rails bent and mounted as shown in the accompanying drawing. This gate is raised by an air-operated hoist and when the metal fingers are released they promptly work down through the stream of muck to effect closure. The angle at which the fingers are hung is a factor in the satisfactory closing and the spacing of only ¾ in. between



SKETCH OF TIMBER FINGER GATE AT WEST PORTAL

the rail bases effectively prevents the escape of any considerable quantity of fines when the fingers are down. On the other hand, any large pieces of rock coming down the chute and requiring a somewhat larger space than the normal opening affords, have only to raise the weight of one or two fingers to pass through without choking the flow.

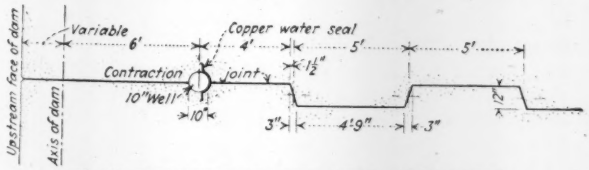
A less pretentious form of finger gate made largely of wood, faced with metal plates, is in use on the bunkers at the west portal. This gate has five fingers made of 4 x 6-in. timbers and the hinge is at the angle of the fingers instead of at the upper end. The timber gate is operated by hand with the aid of block and tackle attached to the outer ends of the lever arms.

Improved Type of Copper Water Seal for Concrete Dams

By C. E. Pearce
Recently Designing Engineer, Exchequer Project, Merced, Calif.

In designing the Exchequer dam for the Merced Irrigation District in California, endeavor was made to develop a copper water seal for contraction joints that would avoid the difficulties attending the use of seals of the common types. The result was the seal shown in the accompanying drawings and described in the following.

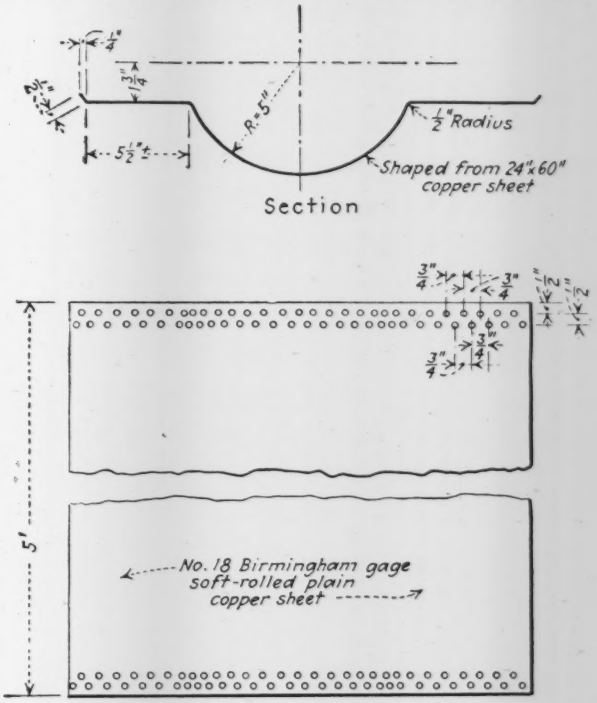
The common bellows type of water seal involves sharp bends in the copper sheet and in places the sheet has



PLAN SHOWING WATER SEAL AND WELL

to be folded back against itself which makes effective riveting difficult. Welding or brazing can be substituted, of course, but this makes the joint stiff and brittle so that there is danger that the weld will crack or break in the bend where hinge or bellows action must take place if the seal is to function. Seals of this type, moreover, require use of an asphaltic filler which materially increases their cost.

In searching for a better type of seal the governing factors were effectiveness, simplicity, economy, ease of installation and ease of connecting joints in the field. The seal developed to meet these conditions is shown in place on the contraction joint in an accompanying drawing. The curved part of the copper sheet fits on the inside of a drainage well 10 in. in diameter, for a little less than one-half the circumference, the copper sheet being on the downstream side of the well. The well was made circular rather than of some other shape because of the ease in removing circular forms. The wings on either side of the circular portion of the seal are embedded in the concrete about 6 in., the outer ½ in. on



DETAILS OF THE COPPER SHEETS

each end of the wings being bent to prevent slippage in case the bond on the wing was insufficient.

The sheets were punched and bent all exactly alike, at the factory, where they were nested and crated for shipment so that they were received on the job all ready for assembly. The sheets were interchangeable and would fit either end up.

Theoretically, two curved surfaces of no thickness may be nested so that rivet holes will match, if the rivet holes are punched alike in both sheets. But as the sheets or plates get thicker, the holes at the two outer edges get farther and farther out of line. With sheets as thin as the 18 gage used in this case the misalignment of holes near the tips of the wings was hardly perceptible and the sheets went together easily.

Nine-gage tinner's copper rivets $\frac{3}{32}$ in. long were used and were put in cold. The riveting was very easily and quickly accomplished as there were no sharp bends or corners in any part of the seal. The copper sheets were ordered in 5-ft. lengths so that this would be the maximum projection above the forms at any time, thus avoiding interference with the counterbalanced chutes of the concreting system.

The 10-in. well was made by using a collapsible cylindrical form against which the copper sheet was

tightly fitted. The concrete was then poured against the form and the sheet. When the form was removed the copper sheet remained as the lining on the downstream portion of the well. On the Exchequer dam, metal collapsible forms about 5 ft. long were used while on the Balch diversion dam of the San Joaquin Light & Power Corp., where the same type of seal was later used at the suggestion of the writer, an improvised wooden form with removable wedges in the central portion was employed. Both methods worked very satisfactorily. The same type of seal has also been put in in the Melones dam of the Oakdale Irrigation District.

The action of the seal is apparent. When the two parts of the dam separate the copper sheet spans the opening by leaving its seat against the concrete and moving slightly upstream. When the two parts come back together the copper again seats against the concrete.

The size, weight and cost of the copper seal as used in the Exchequer dam are:

Total length	3,400 ft.
Total weight	18,000 lb.
Material cost, delivered at dam	$1.20 per ft.
Contractor's bid for installing	1.00 per ft.
Total cost installed	$2.20 per ft.

R. V. Meikle was chief engineer of the Exchequer project; Ross White, resident engineer; A. J. Wiley, consulting engineer, and Daniel McFarland, construction engineer.

Concrete Floor on Bridge Poured from Plant Floating Alongside

IN PLACING the concrete floor on the four main spans of the recently completed Ross Island bridge across the Willamette River at Portland, Ore., it was found economical to use a floating plant because of the convenience and low cost of water transportation. Floating equipment for mixing and hoisting concrete was therefore assembled, together with suitable bunker and cement storage capacity on barges, and the ensemble was moored on the downstream side of the bridge. With this plant a total of 2,434 cu. yd. of concrete was delivered to the deck of the bridge and distributed by hand buggies to the point where paving was in progress. A length of about 1,800 ft. of the bridge was paved in this way from five moorings of the floating plant.

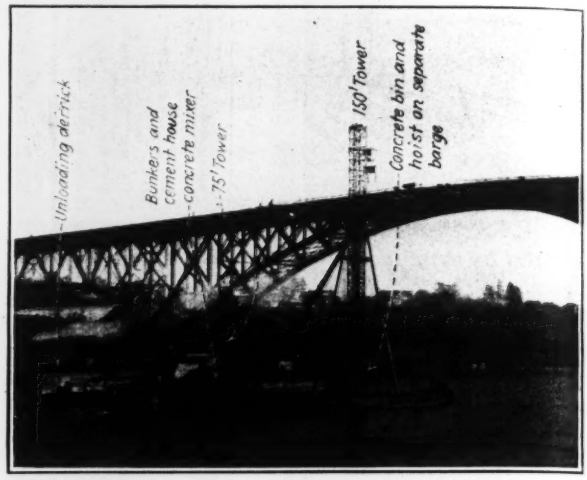
In the main, the floating plant included: (1) a barge carrying a weathertight cement house with a capacity of about 6,000 sacks; (2) a hoist operating a derrick boom equipped with a 2½-cu.yd. grab bucket for unloading sand and gravel from barges to bunkers; (3) bunkers for sand and gravel with capacities of 12½ and 25 cu.yd., respectively; (4) a mixer shed containing two 1-cu.yd. mixers delivering to (5) a 75-ft. hoisting tower with 1-cu.yd. skip. From this tower a steel chute delivered to (6) a concrete bin and hoist on a separate barge whence the concrete was discharged into the skip of (7) a 150-ft. tower which, with braces and guy cables, occupied a 40x120-ft. barge.

With this equipment the plan was to have sand, gravel and cement barges alongside all the time, keeping the bunkers filled to capacity to avoid delay while the barges were being changed. The short tower was a means of convenient delivery to the 150-ft. tower which was carefully braced and balanced so that the tower could be kept as nearly plumb as possible while the skips were operating.

The charge for each mixer was a 10-sack batch using a 1:1:2 mix; as delivered this amounted to about ⅔ cu.yd. per batch. Using both mixers it was therefore possible to deliver ⅔ cu.yd. batches to the floor level as fast as the skip could be operated, which was about 1 batch per minute, thus delivering an average of about 450 batches per day.

From Job and Office

HINTS THAT CUT COST AND TIME



FLOATING CONCRETE PLANT AT ROSS ISLAND BRIDGE

Electrical Cableway Specifications for Construction Work

BY ROGER F. EMERSON
Industrial Engineering Department, General Electric Co., Schenectady, N. Y.

SINCE practically all power generated by large modern power stations is alternating current, electrically-operated cableways on construction work use alternating current motors because the power is taken from the nearest transmission line. This form of current lends itself best to transmission over long distances with minimum transmission losses. Furthermore, the induction motor, being simple and sturdy and probably the best suited in many ways for rough usage, is adapted to cableway work. The induction motor is inherently a constant speed machine. Though cableways usually have a trolleying speed several times faster than their hoisting speed, this change in speed is usually taken care of in the cableway mechanism.

Ordinarily there are two considerations in determining the proper size of a motor for any duty.

(1) Is the motor big enough to execute the required cycle of operations without getting hotter than the manufacturer guarantees as the highest permissible limit?

(2) Is the motor big enough to exert sufficient torque to accelerate in a reasonable time the biggest load that the equipment will ever be called upon to carry?

From Job and Office

FOR CONTRACTOR AND ENGINEER

It has been the writer's experience that the first consideration need never be taken into account in the case of a motor for operating a cableway. If a motor is selected large enough to accelerate a loaded bucket either from rest in the hoisting direction or for propelling against the maximum grade of the cableway wire, it will be so large that its temperature rise will never approach the limit as set forth by the motor manufacturer. An actual cableway's performance was:

Full load carried each trip	10,000 lb.
Weight of empty bucket	2,000 lb.
Weight of loaded bucket	12,000 lb.
Bucket speed, hoisting (3-part line)	300 ft.p.m.
Rope speed, trolleying	900 ft.p.m.
Distance trolleyed	300 ft.
Distance hoisted	220 ft.
Time for hooking and unhooking load, etc.	20 sec.
Mechanical efficiency between load and motor shaft	75 per cent
Maximum grade on cableway wire encountered by trolley carrier	20 per cent

The power required to hoist will be obtained from the following formula:

$$Hp. = \frac{WS}{33{,}000\,E}$$

where E is the efficiency between motor pinion and the load; W is the weight of hoisted load in pounds; S the hoisting speed in feet per minute.

Then,

$$Hp. = \frac{12{,}000 \times 300}{33{,}000 \times 0.75} = 146\ hp.$$

The power required to propel the loaded bucket against the maximum grade of the cableway will be:

$$Hp. = \frac{[(WG) + (TF)]\,R}{33{,}000 \times E}$$

where W is weight propelled in pounds,
G is the grade of cableway wire in per cent,
T is the weight propelled in tons,
F is the friction in pounds per ton,
R is the RPM of motor,
E is the efficiency between motor pinion and load.

Then

$$Hp. = \frac{\left[(12{,}000 \times 0.2) + \frac{12{,}000}{2{,}000} \times 35\right] 900}{33{,}000 \times 0.75} = 95.$$

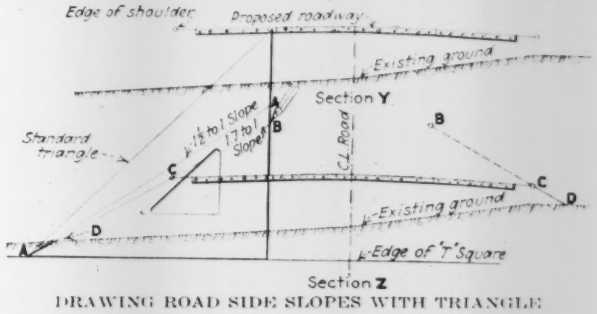
Since the power to hoist the bucket in the vertical direction is greater than the power required to propel the load against the maximum grade of the cableway wire, it is evident that this will be the figure which will determine the size of the motor. Besides the power to hoist the load additional torque is required to produce acceleration. A crane type induction motor is capable of exerting something over twice its full load torque rating with rated voltage applied so that if a standard motor is chosen whose rating is the next size larger than 146 hp. or 150 hp. it should be ample for the job. In case of doubt, refer the operating data as given above to a reputable motor manufacturer who will be glad to make recommendations on a suitable motor with control equipment.

Since a good many cableways may be located some distance from power plants, care should be taken that voltage is not excessively low at the motor terminals because motor torque of an induction motor varies as the square of the voltage. If the voltage is 90 per cent of normal, the motor torque drops to 81 per cent of normal. This will result in longer acceleration periods and in extreme cases would result in stalling of the motor when called upon to accelerate extra heavy loads.

Simple Means of Drawing Side Slopes to Highway Cross-Sections

By Arthur J. Lichtenberg
Bridge Division, New Jersey State Highway Department, Trenton, N. J.

IN WORKING out various highway and bridge problems, it is often necessary to plot a succession of cross-sections showing the relation between existing ground and a proposed fill, the shoulder elevation of the proposed road being known and the ground line known but often variable (Section Y in the accompanying sketch). To plot the slope line from the shoulder of the proposed section to the ground line one must, when unruled paper is used, determine the vertical height and multiply it by the slope to find the point of toe of slope, and lay the horizontal distance off with a scale. When ruled paper is used the slope is generally determined by laying off horizontal and vertical lines to make the required slope and by making all slope lines parallel to the hypotenuse of this triangle. This permits error due to the small scale often used, the multiplicity of operations, and inaccuracy when finely ruled paper is not used.



DRAWING ROAD SIDE SLOPES WITH TRIANGLE

To save time and the possibility of error through making the operation practically mechanical, I have ruled with India ink on a 45-deg. triangle several slope lines such as 1½:1 and 1.7:1, as AB and AC in the sketch. It is necessary then only to place the triangle so that any part of the given slope line is directly over the edge of the shoulder as at C (Section Z). Place a sharp pencil at one extremity of the slope line B and draw the prolongation of the line BC to D, making CD, the desired slope. By turning the triangle over the opposite slope may be drawn quickly and accurately.

Job and Office Note

Rail laying on the Santa Fe in the new Texas oil fields with a small crane operated by a gasoline engine and running on the new-laid track is said to have saved the contractor 40 per cent of his estimated cost and enabled him to complete the work 30 days ahead of schedule. The work is near Panhandle, Texas, and is part of a 75-mile extension of standard-gage track. The contractor was Hamilton & Gleason, Denver, and this information was supplied by the Parsons Co., Newton, Iowa.

Letters to the Editor

A FORUM FOR DISCUSSION OF VIEWS OF ENGINEERS AND CONTRACTORS

Disposal of Excavated Material, New York City

Sir—We noticed in the Nov. 18 issue p. 816, under the article "Open Foundation Plant and Methods on Manhattan Island," that you have a photograph marked Fig. 8, of our dump board at Pier 69, North River. We wish to advise you that this dump board was constructed by us, and the trucks shown in the picture dumping, the dump scows, and the seagoing tug "Tuarr," are owned by our company, thus making a complete unit for hauling and conveying to sea all excavated materials from two sections of subway construction, constructed by the G. H. Flynn Corp. and the Rosoff Subway Construction Co., from 18th to 38th St., on 8th Avenue. As far as we know we are the only concern who have handled the hauling and disposal end, from start to finish.

New York City, Nov. 20, 1926. SAMUEL ROSOFF, President, Samuel Rosoff Co., Inc.

[The illustration of Mr. Rosoff's dumping board was published because it shows such a structure to fine advantage and in spite of the fact that it is used for subway spoil. Other dumping boards are similar. The article, however, considered only building foundation practice and pointed out subway construction as a special case not within its scope.—EDITOR.]

Salaries of Federal Judges

Sir—Are the federal judges entitled to increased pay as claimed by E. J. Prindle and Dexter S. Kimball of the patents committee of American Engineering Council? Should the engineer write his representative in Congress favoring such advanced compensation? Does the exhibit of mechanical common sense by the federal bench warrant such support?

Judge Rosalsky of New York City had before him three boys recommended for commitment to an institution for feeble-minded and asked them if a horse standing on four legs weighed 800 lb. what would it weigh if it stood on three legs; the boys reasoned it would weigh 600 lb. Lack of mechanical common sense was sufficient to commit the youngsters although they appeared to have three-quarters the mechanical sense of the ordinary laborer.

Examining the judicial decree of the eighth Circuit Court of Appeals that putting the steel on the top of a concrete floor is the plain mechanical equivalent of putting it in the bottom we see that three-quarters of the mechanical sense of the laborer entitles the poor youngsters to commitment to an institution whereas if the percentage passes through zero or becomes a negative quantity it is sufficient to sit on the federal bench and command an increase in compensation for the impious reversal in law of the mechanical rules which the creator has ordained for the regulation of the universe.

Were this an error of merely three mistaken judges it would be unfair to cite the fact as indicative of the mechanical intellect of our body judicial but after such decree is concurred in or agreed to by about twenty-five of the judicial bench it may be taken as a gage of the mechanical sense of our present patent decrees. How much did the legal entity of comity have to do with the judicial comedy of opinion?

A careful study of numerous judicial decrees warrants the conclusion that the average inability of the lawyer judge to decide questions of structural mechanics is about nine in error to one chance finding in accord with established principles.

The position of Messrs. Prindle and Kimball has been defined by Clarence Darrow in his Kansas City speech, "The Bar Association can be counted on to favor appointment of a court to decide any kind of question and immediately recommend an increase in salary thereafter. Advance in pay without the qualification of competent scientific ability will be a step backward rather than forward."

Under our judicial system the judge unfamiliar with the art or the mechanical principles involved sometimes declares that thing new and patentable of antiquity greater than the Christian Era and the long suffering public are blackmailed from Maine to California of one-half to three-quarters of a million dollars as the result of an honest but mistaken opinion. In Canada and England the procedure of *scire facias* for revoking a patent issued by error or inadvertence prevents such blackmail as United States citizens are subjected to. But what strenuous opposition to this just procedure is offered by our patent law committees!

In an engineering office if the engineer is more often wrong than right he gets the grand bounce—does the judge get a raise in salary with the support of the engineer? Is the writer's position unjust? Let us refer to the report of the committee of the Patent Law Association of Chicago in their report on the Oldfield Bill "That patent litigation is expensive, its results uncertain and decisions conflicting must be admitted." And for this admitted uncertainty and error the engineer as a citizen is asked to vote an increase in pay!

That mechanical common sense is most needed on the bench in patent litigation may be conceded without argument yet it is most completely lacking in the legal profession. Germany borrowed the United States Patent Office system bodily but in its legal procedure the lawyer judge is permitted only to apply the law to a state of facts determined by experts, and America will encourage progress best by following that example.

Minneapolis, Minn., Nov. 23, 1926. C. A. P. TURNER, Consulting Engineer.

Aurora Borealis Again

Sir—In your issue of Nov. 4, p. 756, I notice a communication from John H. Burleigh regarding the effect of aurora borealis on the magnetic needle.

In the fall of 1882 I was engaged on a wild land survey in the town of Surry, in this state, and another man employed on the same work tried to impress upon me the great saving of time to be made by using the compass. One day partly perhaps to humor him, I tried it. Having a lot to go around that could in no way affect the rest of my work I started in with the compass. It was a dreary dull gray day (Nov. 17 by my record book). I ran up one side, the lot being long and comparatively narrow, and about noon set the compass over the corner stake and swung to the proper course for the head line. In a few minutes I happened to look at the needle and found it 2 or 3 deg. out. I supposed I had made a mistake in setting and so turned to the required reading again, only to find in a few minutes the needle as far off again. At night I took the compass in, put it in its box and never tried it again. That evening the cause was plain to be seen—a brilliant display of aurora—and the next morning before daylight a display even more wonderful.

Rockland, Me., Nov. 22, 1926. O. H. TRIPP, O. H. Tripp Engineering Co.

Tremie-Placed Concrete vs. Concrete Air Cured and Then Submerged

Sir—From an editorial appearing in your Oct. 28, 1926 issue, p. 689, commenting on the tunnel now being constructed under the Oakland Estuary, the following excerpt is taken: "It is well known, however, that concrete placed in air and properly cured before being submerged has better prospects of life than concrete placed below water and subject to the many possibilities of insufficiency that that process involves."

I am inclined to take exception to this statement in the light of our experience on the Detroit River tunnel. It must necessarily be assumed, if your statement is correct, that concrete placed in air and properly cured before being submerged is superior in quality to tremie-deposited concrete.

The following facts are matters of engineering record in connection with the Detroit River tunnel work. For the most part our tremie-deposited concrete was of a 1:3:6 mixture. Core boring samples were taken from one of the pockets, and between the tubes, with a 6-in. calyx shot drill, which gave us a core about 5 in. in diameter. This particular test was made through 35 ft. of solid tremie-deposited concrete and cores were obtained for 92 per cent

of this depth, ranging in length from 6 to 20 in. The depth of the water varied, if I remember correctly, from 35 to 40 ft. at the top of the concrete deposit to 70 or 75 ft. at the bottom. Sections of this core were selected at random, some 6 in number, and when tested in compression developed a strength ranging from 2,740 lb., the lowest, to 4,000 lb. per sq.in. The samples were taken and tests made about one year from the date of deposit.

About the same time we took similar core boring samples of 1:3:6 concrete from one of the heavy retaining walls in the west approach. This concrete had been placed in the air, under the most ideal conditions; had been allowed to cure more than a year and was supposed to be about the best that could be made for the purpose required. These samples developed a maximum compressive strength of about 2,277 lb. per sq.in. It will be noted that the minimum strength shown in samples of tremie-deposited concrete was greater than this maximum shown for open air concrete of the same mixture.

I do not believe that concrete placed in air and properly cured before being submerged has better prospects of life than concrete placed below water. It has not the density to start with, and its character is such that it will not take on density or other attributes that will make it superior to, or even comparable with, tremie-deposited concrete.

New York City. W. S. KINNEAR,
Dec. 3, 1926. W. S. Kinnear & Co., Engineers.

Noted Engineer Supports Mosquito Control Measures, But Not by Bats

Sir—Sanitary engineers and civil engineers did such excellent work of mosquito control about military cantonments in the malarious sections of our country during the recent war that it would be most unfortunate if this record should be decidedly neutralized by other American engineers following the advice given in the letter published in *Engineering News-Record* of Oct. 28, 1926, p. 718, and erect a line of bat roosts along our coast as a monument to enthusiasm for an untested idea that will not stand up under an engineer's investigation.

If anybody becomes too enthusiastic about building bat roosts to eliminate disease bearing or pestiferous mosquitoes there are known remedies for this fever. On pp. 69 to 77 of the 1916 Annual Proceedings of the New Jersey Mosquito Extermination Association is conclusive evidence that bats can not compete with American engineers in successful mosquito elimination. Copies of this bulletin may be found in many city libraries and may be got from the Agricultural Experiment Station, New Brunswick, N. J. Any engineer who attends the annual convention of this association will be convinced the conferences are of considerable practical value to all really interested in mosquito control. Again, United States Public Health Service Reports, Reprint 715, July 30, 1920, available on request to the Public Health Service, Washington, D. C., demonstrates conclusively that bats are inferior to engineers when it comes down to permanent mosquito elimination on a wholesale scale.

The editorial note on the 1926 mosquito pest situation in our eastern states in *Engineering News-Record*, Sept. 30, 1926, p. 527, for purposes of comparison states that entomologists cleaned the mosquitoes out of Panama. Such was not the case. The writer of this letter directed the mosquito control work on the Isthmus of Panama as well as the first malarial control and yellow fever control campaigns at Havana, Cuba, in 1901-1902, and is an engineer specializing in mosquito control, and not an entomologist. These facts were reported in a paper presented at the Annual Convention of the American Society of Civil Engineers at Philadelphia Oct. 6, 1926. I desire to state that entomological investigation is essential to economic and effective mosquito control procedure and that it is because our public do not have better knowledge of practical facts determined by entomologists that they make such wild guesses as to the sources and causes of mosquito prevalence. The information is in print and may be had by requesting it.

After hearing the numerous glowing accounts of what bat roosts can be made to accomplish, I personally visited the old bat roosts at San Antonio, Texas, and was sadly disappointed. I made a field inspection of the vicinity of the bat roosts and waded into nearby potential breeding places of mosquitoes with several other investigators. We found prolific breeding of three species of Anopheles (the malaria conveying mosquito) close to the bat roost at the edge of the city and also numerous adult mosquitoes in the usual daytime resting places close to the bat roost. Many of them were gorged with blood and it would be of interest to determine whether some of them got it from the bats. We then proceeded to the bat roost near Mitchell's Lake where mosquito larvæ were numerous in the nearby stream bed, and in the swampy area close to the highway. In outbuildings at a farm house at the top of the hill, the pestiferous mosquitoes were so numerous you could hear them and it takes mosquitoes in quantity to produce that sound. I have no theories and think a good way to see is to go and look for yourself and to take some impartial witnesses along with you and that is what I did. A subsequent inspection of the city of San Antonio in 1923 showed that 70 per cent of the city blocks contained breeding places of Stegomyia.

Near Gulfport, Miss., is a well-built bat roost and not a bat considers it worth living in, and in the early days of canal construction at Panama, in 1904 and 1905, bats were very numerous in the attics of many of the houses but they in no way reduced the production of mosquitoes in any water containers close to any bat infested home.

It is difficult to understand why so much misleading information has been given wide publicity and approval by persons who made no real investigation of the subject and never visited the prolific sources of mosquito breeding close to existing bat roosts.

I am not connected with the work being done in New Jersey but have followed its progress and been over a number of the county projects. Incidentally I have been engaged in mosquito control investigations and control campaigns for about twenty-five years and it is my impression that engineers will find it highly advantageous to investigate what is being done in New Jersey rather than to condemn what has been accomplished without having the slightest idea of what the problem is or of the present method of control procedure.

During the world war when military cantonments were established in the malarious sections of the South, we looked up the records of deaths from malaria in our camps in the Spanish-American and Civil War and were astounded to find that we were due to lose about five thousand men from malaria if the same malaria rates obtained. The engineers associated with the writer directing the antimalaria measures at our camps held this menace down so well that in place of 5,000 we had but 36 deaths from malaria. I would not call that result a theory and it is no more practical than the excellent work now done in applied entomology.

Those who do not know of the numerous difficulties mosquito control field workers have to contend with, many of which are created by the uninterested public, could learn much by spending a few days investigating the situation they complain of and then they might come to the same conclusion as a newly appointed inspector did when sent to Panama. When jollied about mosquito prevalence in his district he said, "It's really more to your personal advantage to help to destroy mosquitoes than to attack the mosquito fighters."

Full information as to the causes and reasons for the unusual prevalence of pestiferous mosquitoes in New Jersey in 1926 can be obtained from the Agricultural Experiment Station, as above mentioned, but, everything considered, it is probably advantageous that their work was severely criticised in the leading engineering journal of America, as that may create a wider interest in mosquito control and cause a number of people to take a personal interest in mosquito freedom and thus assist in removing the constant obstructions and difficulties that mosquito field workers have to face.

One good test of the actual value of the work that has been done would be to eliminate all maintenance work and rely solely upon bats for a year or two whereupon the drop in real estate values would be such that all would be convinced that the work as now being conducted in New Jersey has an annual value of more than the sum total spent to date in that state for mosquito elimination. It is not generally known that the public of the United States is buying from the mosquito screen manufacturers probably between $20,000,000 and $25,000,000 worth of mosquito screens a year. This statement was given out by a late

general manager of one of the largest screen manufacturing firms. It costs about as much to install the screen as to buy it. We are paying then a considerable sum to be held prisoners behind the last line of defense and it would be interesting to compare that annual payment with the total amount spent to eliminate the cause of necessity for screening. The whole situation has been very well covered by Dr. T. J. Headlee in short bulletins, 423 and 437, New Jersey Agricultural Experiment Station, New Brunswick, N. J., and it would be of great benefit to those who are pestered by mosquitoes or interested in mosquito elimination to read them. Studies of mosquito prevention indicate conclusively that the number of mosquitoes varies inversely as the intensiveness of antimosquito work and it is in areas where mosquito work has been most intensively and extensively carried on that mosquitoes are scarcest.

Memphis, Tenn. J. A. LE PRINCE.
Nov. 5, 1926

[We hold no brief for the bat plan of mosquito control against which most of Mr. Le Prince's letter is directed. We may state that although not writing in that capacity, Mr. Le Prince is senior sanitary engineer, U. S. Public Health Service, a fact which many of our readers know but some may not.—EDITOR.]

Heavy Rainfall and Runoff in Catskill Watershed, New York City

Sir — The accompanying figures and comment on the recent heavy rainfall and runoff in the Esopus and Schoharie watershed gathering grounds affording what is known as the Catskill water supply, New York City, appear to be of general engineering interest.

On Nov. 15 and 16 there was a rainfall throughout both watersheds. Although this was a general rainfall, there was a great variation in depth, the maximum intensity appearing to be reached on each side of the divide between the Schoharie and Esopus watersheds. There are ten gaging stations in the Esopus watershed and eight in the Schoharie. The rainfall record reported for these stations is:

SCHOHARIE	Inches	ESOPUS	Inches
Windham	3.25	West Hurley	2.48
Elka Park	7.70	Brown Station	2.26
Lexington	4.26	West Ashokan	3.94
Prattsville	3.20	Cold Brook	3.75
Grand Gorge	1.73	Lake Hill	4.18
Manor Kill	2.40	Phoenicia	6.12
Gilboa	2.17	Edgewood	6.05
West Kill	4.30	Slide Mountain	5.93
		Pine Hill	5.29
		Big Indian	3.65
Total	29.01	Total	43.65
Average	3.626	Average	4.365

On the basis of the average rainfall, the water that fell on the Schoharie watershed amounted to 19,900 m.g.d. and on the Esopus watershed 19,500 m.g.d., or a total of 39,400 m.g.d. On the 16th the flood in the Esopus watershed was the highest recorded since records were first taken in this watershed in about 1903, the creek in places covering the state highway and reaching a maximum rate of flow of about 37,500 sec.-ft., or 24,000 m.g.d. On Nov. 16 the amount that flowed off the two watersheds was prectically the same, being in round figures 11,600 m.g. We estimate that, after making due allowance for the water that was in the ground, and for a rainfall of about ½ in. on Nov. 26, the runoff from the storm on Nov. 15 and 16 represented about 92 per cent of the rainfall. It seems reasonably certain that the average rainfall in each watershed was actually in excess of the average shown by the gages. This is of interest as pointing to the erroneous conclusions that may be drawn from rainfall records where stations are much farther apart than those in the two Catskill watersheds. In the Esopus there are only 257 sq.mi. of tributary watershed, and 10 rainfall stations; in the Schoharie there are 314 sq.mi. of watershed, and 8 gaging stations, and yet it is certain that at times the rainfall obtained from such gaging stations will not give a true picture of the actual rainfall over the entire watershed.

The Gilboa reservoir rose 54 ft. in one day, and reached a maximum level of 5 ft. below the spillway on Nov. 23. It was necessary to shut off the flow through the Shandaken tunnel during the flood, and to maintain the tunnel shut off for about a week thereafter, due to a pier of a bridge in the Esopus creek having been seriously undermined by the flood. The Shandaken tunnel is delivering about 660 m.g.d. from the Gilboa reservoir into Esopus Creek, and the reservoir level is slowly falling. Both the west basin of the Ashokan reservoir and the Gilboa reservoir are filled with a very turbid water, the turbidity averaging somewhat over 100. It is considered essential to use for the first time a coagulant to reduce the turbidity of the Catskill water. This coagulant will be added at the Pleasantville plant, which was built by the Board of Water Supply for this purpose, and the sedimentation will take place in the upper end of the Kensico reservoir.

The east basin of the Ashokan reservoir is being emptied of the last couple of billion gallons of clear water, and then the turbid water from the west basin will flow into the east basin and be allowed to stand as long as possible. It seems probable that while previously we have been able to use Catskill water after a period of sedimentation of about five weeks, when the turbidity has been raised by a heavy storm, that a longer period of sedimentation will be required due to the higher turbidity of the Schoharie water and the unusually large amount of fine clay that was brought into the reservoir by the extent of the flood, the greatest rainfall being on areas where fine clay would be likely to be washed into the stream.

The low point of storage in the Catskill system was reached on Oct. 24, when there was 15,255 m.g. in the Ashokan reservoir, and virtually none in the Gilboa reservoir. On Dec. 1 the combined contents of the Ashokan and Gilboa reservoirs was approximately 58,600 m.g.

It is interesting to compare the rainfall for New York City with the rainfall in the Catskill watersheds during the month of November. The Central Park rainfall for the month amounted to 3.99 in., as compared with 7.47 in. for the Esopus watershed. Last summer the rainfall in New York City was greatly in excess of the rainfall in the Catskill mountains.

I believe that the data given herein are of general engineering interest, as well as being of special interest to New Yorkers.

WILLIAM W. BRUSH,
New York City, Acting Chief Engineer, Department
Dec. 3, 1926. of Water Supply.

Italian Autostrada Are Primarily Speedways

Sir—The editorial comment, in *Engineering News-Record*, Nov. 4, 1926, p. 729, in reference to the special motor roads favored by the continental Europeans of the International Road Congress at Milan does not seem to me fully to bring out the fundamental difference between the Milan-Lake Como highway and the through express highways being built or planned in this country.

The road from Milan to Lake Como is, as I understand it, built almost exclusively for speed and only in a very minor degree to relieve congestion. My recollection of the country is that an ordinary improved road of a type say similar to the Boston Post Road, 36 ft. in width, could handle all the traffic there with ease. This impression of mine may be subject to correction as it is some time since I was there, but I believe the underlying principle of such roads in Europe is to provide speedways.

The so-called express or arterial highways in this country are being built to relieve congestion in city streets, by bypassing the through traffic around the congested areas. They thus serve two purposes, one to provide much needed additional facilities for existing and future traffic, and in addition to that relieving the streets in the business centers of traffic which impedes or in many cases almost entirely prevents their use for the primary objects for which they were intended.

There is therefore ample justification for having the whole community, that is, in most cases, the state, pay at least some part of the cost. A part of this is of course paid by the owners and users of motor vehicles through the automobile tax, and in many cases the gasoline tax. It is possible that in some cases a toll should be collected but if it is it should probably be only for a small portion of the cost of providing and maintaining these highways.

Jersey City, N. J., F. LAVIS,
Dec. 6, 1926. New Jersey State Highway Department

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Illinois Road Contractors Advocate Cost-Records

Itemized Costs Important for Bids, But Uniform Basis Needed—Main and Secondary Roads

Cost records as a vital necessity for success in the contracting industry, with their neglect as a cause of the large mortality among firms in this industry, were the main subjects of discussion at the largely attended annual meeting of the Illinois Association of Highway and Municipal Contractors, held at Chicago on Dec. 15 and 16. Failure to keep or use cost records is the main cause of low-bidding by experienced contractors, according to A. E. Horst, Rock Island, Ill. For such low-bidding by contractors of little experience, one main reason is failure to allow for depreciation of equipment and the consequent value to be charged off; another reason is that these men (often former superintendents or foremen) have no comprehension of the many charges for loss, emergency and overhead which have to be covered by the bid.

Material Costs

A series of papers and talks dealt with costs of materials, material handling, transportation, concrete mixing and placing, and earth grading and shoulders. A paper by S. D. Moore pointed out the variations in weight and volume of materials due to local conditions, and the losses in transportation and handling, all of which must be allowed for in estimating quantities to be purchased to produce a certain output. In the discussions, several speakers gave itemized costs, but Mr. Horst pointed out that if comparisons of such costs are to be made some uniform basis is necessary.

The association's field engineer, A. H. Hunter, was listened to with great attention when he submitted and explained tentative forms for estimates on road work, which included several items which are often neglected or overlooked. Other forms were for estimates on depreciation and repair of equipment, giving average percentages of cost. As an example of the practice of bidding simply to get a contract, one speaker stated that on certain road work the bids ran at about $38,000 per mile, but the department stated that no contracts would be let at more than $30,000. On the second bidding, many of the same bidders put in prices at about $29,990. In commenting upon the necessity of unit prices, Mr. Hunter pointed out that this is not merely a local or state matter, since bids on one Illinois job included outside bidders from New York, Texas and Minnesota.

Highway work and prospects were also considered, a review of state work in Illinois being given by Frank T. Sheets, chief state highway engineer, who explained that it is expected to build 1,000 miles next year and to let contracts for 175 miles in January. In an address on "Secondary Roads," D. O. Thomas, county superintendent for St. Clair county, pointed out that classification of roads is indefinite, since the primary or state-bond road system as devised by the engineers is changed by the legislature for political reasons. Many secondary roads carry heavier traffic than the socalled primary roads, but the counties have little money for their improvement. He favored a gasoline tax, with 80 per cent returned to the several counties for their roads. He thought motorists would approve this, although they opposed such a tax to supplement work on the state's bond-issue roads. In this way the road system could be extended materially without increasing the state's responsibility, while additional work would be provided for contractors.

Engineering Fifty Years Ago

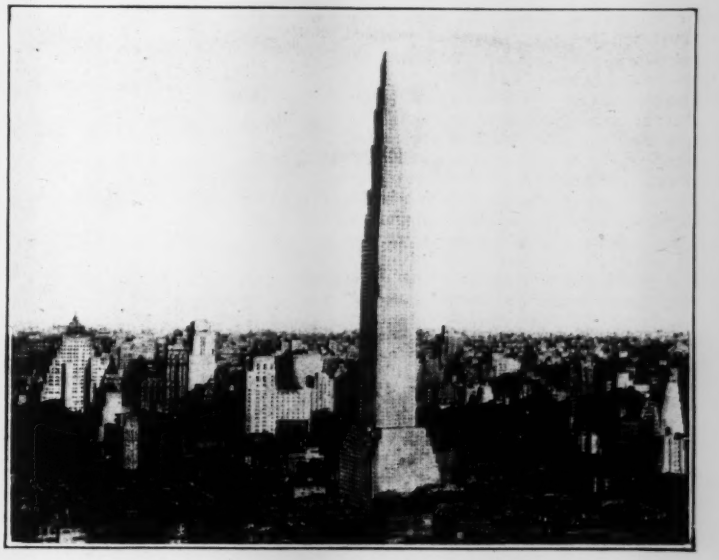
From *Engineering News* of December 30, 1876

PROFESSOR HUXLEY, at a London lecture, recently gave some striking instances of the ill-effect on public health of neglect of drainage, and showed by the case of the town of Salisbury, that consumption, which was more fatal than all the zymotic diseases, might be diminished as much as fifty per cent, by thorough drainage of the subsoil.

Building of 110 Stories Proposed for New York

Plans Filed for Tower Structure 416 Ft. Higher Than Woolworth Building —Near Times Square

Plans have been made and filed with the Manhattan Bureau of Buildings for the construction of a 1,208-ft. tower building of 108 stories above ground in New York occupying 50,000 sq.ft. on the south side of West 42nd St., between 8th and 9th Aves. The estimated cost is $18,000,000, to which is to be added the value of the site placed at $4,500,000. The new building has been designed by John A. Larkin and Edward K. Larkin, architects and engineers, and Alexander D. Stark, structural engineer. It will be of steel, limestone and brick, the foundations being on solid rock. On the 42nd St. side the building will rise 12 stories followed by 4 setbacks to the base of the 90-ft. tower resting on the 18th story. The tower reduces in area by means of six setbacks as it rises to the top three floors. These latter will be given over entirely to sight-seeing purposes.



BUILDING 1208 FT. HIGH PROPOSED FOR NEW YORK

Pending the approval of the Bureau of Buildings, no information is available concerning the structural plan to be used. Sixty high-speed elevators are proposed, two of which will be express to the 82nd story where passengers will be served by four shuttle cars ascending to the top of the building. The sixty elevators will be arranged in 10 banks centered in the building from north to south. There will be no interior courts. Beneath the building will be a basement and a sub-basement.

Utility Regulation to Be Subject of Discussion at St. Louis

When the American Economic Association meets at St. Louis, Mo., Dec. 28-31, the subject of public utility regulation will be one of the chief items of discussion. There will be a round-table conference in charge of Dr. John Bauer, of the American Public Utilities Bureau, to consider whether the common system of regulation has worked satisfactorily and, if not, what can be done to make regulation effective and financially sound. Special questions to be considered will be whether the reproduction cost or the actual investment theory is the most suitable basis for rate making. There will be papers by Prof. Robert L. Hale and Prof J. C. Bonbright, of Columbia University; Prof. H. G. Brown, of the University of Missouri; Prof. Martin G. Glaeser, of the University of Wisconsin, and Prof. C. E. McNeill, of the University of Nebraska.

Deepening of Missouri River for Waterway Approved

Plans for the deepending of the Missouri River from Kansas City to Sioux City, Iowa, so as to provide for a channel 6 ft. deep and 200 ft. wide as far as Omaha at an estimated cost of 28,000,000 which were opposed by Gen. Jadwin, Chief of Enginers, in a report made to Congress on Dec. 17, have been approved by the Senate. The project had been recommended by the Board of Engineers for Rivers and Harbors.

General Jadwin summarized his opposition in saying that "the economic situation will become much clearer and more definite in a few years, especially when the section below Kansas City shall have been improved sufficiently to permit economical navigation and shall have an opportunity to demonstrate that commerce on that section will develop to an amount adequate to justify its large cost of improvement." Gen. Jadwin did recommend, however, that if local communities will provide at least 40 per cent of the cost, the government should undertake certain bank protection work on this portion of the river which will help to stabilize the channel and will be of value when the larger project is undertaken. He estimates that this work will require a contribution from the government of about $6,000,000.

Despite the adverse report by the Chief of Engineers the Senate on Dec. 18 adopted an amendment to the Missouri River project feature of the Rivers and Harbors Bill, providing for the improvement of the Missouri River between Kansas City and Sioux City, Iowa, and providing for the appropriation of $12,000,000 for the prosecution of the project.

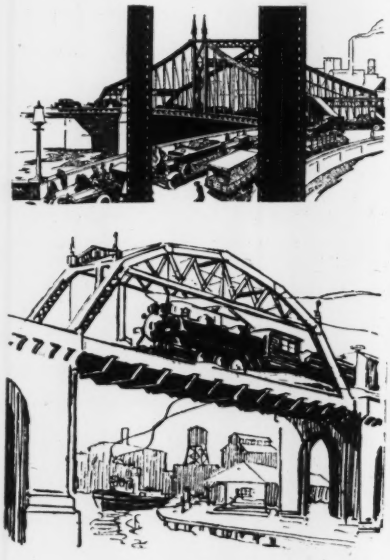
The Senate Committee on Commerce also voted to propose an additional amendment to the Rivers and Harbors Bill to the effect that "hereafter no recommendations shall be made by the engineers of the Secretary of War for contributions by local communities toward the construction of works for the improvement of our rivers and harbors, and in carrying out the projects adopted in this act, they shall be treated as if no recommendations for contributions have been made and appropriations are authorized to the full amount estimated to complete the same."

Work Begun on New Ohio River Bridge

The Gallia County, Ohio, River Bridge Co. has begun work on the proposed bridge across the Ohio River between Point Pleasant, W. Va., and Kanauga, a suburb of Gallipolis, Ohio. The bridge will be a suspension structure of about 700-ft. span, with a paved roadway 28 ft. in width and one 4-ft. sidewalk. It will connect Columbus, Ohio and Charleston, W. Va. by the most direct route, and will form a link in the Midland Trail to the east and south. Charles Evan Fowler, 25 Church Street, New York City, is chief engineer for the company; and C. T. Morris of Columbus, Ohio, is consulting engineer.

RANDOM LINES

Figure These Out Yourself



* * *

Why Uniform Traffic Rules

In Reading, Pa., there is a traffic signal station at the intersection of the river road and the approach to a bridge over the river. One day this summer an out-of-town motorist coming across the bridge wanted to turn to the left and proceeded to do so when the sign by the traffic officer turned to "Go". He didn't get very far before the traffic officer, a Pennsylvania Dutchman, halted him and proceeded to deliver a dialect sermon on the enormity of the offense. But, argued the motorist, "Where I come from we take lefthand turns on that signal." "Well," said the cop "Here id differendt iss. Here vhen d' sign says 'Go,' you schtob, and vhen d' sign says 'schtob,' you go."

Falling Sprinkler Tank Wrecks Building in Philadelphia

On Dec. 18 a 10,000-gal. sprinkler tank resting on a low steel tower on the roof of a three-story factory in Philadelphia fell, and broke through the roof and floors to the basement, wrecking the entire structure and killing four persons. The building was the candy factory of T. H. Wunderle, at New Market and Pegg Sts., occupied since 1873. It consisted of brick walls and timber inside framing. The tank supports rested on 7-in. steel I-beams spanning between 18-in. and 13-in. brick walls at the northwest corner. Columns of two 2½x2½-in. angles resting on these beams and braced by diagonals carried the tank about 8 ft. above the beams.

So far the cause of the collapse has not been determined, but the city bureau of building inspection is investigating. The tank supports had been in place for a number of years, but a new tank was installed last summer. Considerable rusting of some of the supporting members is observable in the wreckage, and one of the struts is broken. The tank fell toward the east, and in carrying down the floors and machinery it also wrecked the front wall of the building. Subsequently it was rumored that an explosion had occurred in the building just before the collapse, but the rumor has been denied.

Reopening of Texas Railway Case Asked of Commission

The Texas, Panhandle & Gulf Ry one of the companies whose application for authority to build new railway lines in the Texas Panhandle was denied recently by the Interstate Commerce Commission, has applied to the commission for a rehearing of the case and a postponement of the order authorizing other companies to start construction. (The order has been issued already, *Engineering News-Record*, Dec. 2, 1926, p. 924). The application of the above railroad was rejected on the grounds that it was without sufficient financial backing to insure its undertaking construction promptly. It now claims that it has opened negotiations with certain trunk railway lines and will soon be able to obtain the necessary backing.

The map of the Texas Panhandle which was published in our issue of Dec. 2 should have shown the line from Estelline to Plainview as extending on in a northwesterly direction to Dimmitt, a distance of about 45 miles, as indicated in the text.

Conservancy District Organized

Owing to the rapid growth of residential towns and communities west of Chicago, steps have been taken for the organization of the DuPage River Conservancy District, embracing about a dozen communities and two sanitary districts. The purpose is to check the uncontrolled discharge of sewage into the river and to provide or supervise water supplies in the interest of public health.

Commerce Commission Reports on Needed Changes in Legislation

The Interstate Commerce Commission, in its fortieth annual report to Congress, emphasizes the need of changing some of the legislation under which it operates in order that it may be better able to handle the problems with which it is confronted. Chief among these changes which the commission suggests is one which will relieve it of the duty of adopting and publishing a complete plan of railroad consolidations before proceeding to approve or disapprove of any particular consolidation. This recommendation was made to Congress last year as was one to the effect that the commission should proceed in a certain manner to keep itself informed of all extensions and improvements in railroad property in order to revise and correct its valuations. The method under which the commission has been operating has been found to be cumbersome and the commission has recommended alternative paragraphs to be substituted in the Valuation Act. The commission also states that the Valuation Act needs clarification both as to the basis for computing excess net railway operating income and the manner of enforcing the provisions of the law.

The commission reports that it has authorized the construction of 1,573 miles of railroad during the year and the abandonment of 592 miles. It has denied application for the construction of 503 miles and the abandonment of 73 miles. In this work, the commission has continued its practice of enlisting the co-operation of state commissions. In 41 cases hearings have been held for the commission by state commissions and in most cases the Interstate Commission has followed the recommendations of the state commissions.

Injunction Issued in Litigation Over Rio Grande Dam

Judge Phillips in the federal court at Albuquerque, N. M., on Dec. 9 granted a permanent injunction against state officials using $25,000 of permanent funds for reservoir and irrigation purposes to start litigation against Colorado over the building of a dam on the upper Rio Grande. It is expected that the incoming administration will be able to settle the matter amicably.

Leading Engineers and Industrialists Honor James H. McGraw

Over 1,000 Celebrate the 66th Birthday of Technical Publisher at a Dinner in New York City

ON DEC. 17 nearly 1,100 of the leaders in engineering and industrial life in the United States met at the Hotel Astor in New York to do honor to James H. McGraw, the president of the McGraw-Hill Publishing Co., Inc., and the McGraw-Hill Book Co. The dinner was organized by a number of men in the electrical industry who felt that Mr. McGraw's contribution to the development of that industry through counsel and through his publications merited some public expression. In developing the idea they decided that there should be brought into the tribute all of the various fields that Mr. McGraw's publications touched. So invitations were extended to leaders in all of the various branches of industrial and engineering activity represented by the McGraw-Hill publications. Mr. McGraw's 66th birthday was selected as the date of the dinner.

The committee which had the dinner in charge had for honorary chairman Thomas A. Edison and active chairman, Arthur Williams, vice-president of the New York Edison Co. John W. Lieb, chief engineer of the New York Edison Co., was toastmaster. The speakers were Willits H. Sawyer, president of the American Railway Engineering Association; Gen. Guy E. Tripp, chairman of the board of the Westinghouse Electric & Mfg. Co.; Charles L. Edgar, president of the Edison Electric Illuminating Co. of Boston; Dexter S. Kimball, dean of the College of Engineering, Cornell University; and E. J. Mehren, vice-president of the McGraw-Hill Publishing Co., and Mr. McGraw.

Each of the speakers testified to Mr. McGraw's staunch personal contribution to the field that the speaker represented and commended the influence of the papers in that field toward better practices and principles. In his reply, Mr. McGraw said in part:

A GREAT satisfaction that I take out of this evening's meeting is that it gives me an unusual opportunity to express in this public way my gratitude to the engineers and industrialists of America for the parts they have played in making possible McGraw-Hill magazines and McGraw-Hill books. Without you, our work could not have been done. Without you, our institutions could not have existed. I thank you heartily for your help, and believing as I do that our institution can be of still larger service, I pray your co-operation for the future.

"While the tributes tonight have been indeed high praise, it seems to me that the principles upon which we have built are quite simple.

"We have held, first, that we should be generous with the reader. We have given him the best we knew how, and have tried to give it in ample measure.

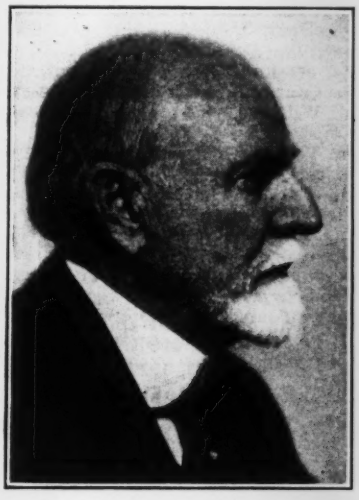
"We have believed that we should never fight for the sheer love of fighting, but that we should never decline to face an issue when the cause was worthy and demanded vigorous action and plain speaking. But even in vigorous sponsorship it has seemed to us that we must speak without passion, 'without vitriol on our pens'; that we should be always constructive.

"We have believed, too, that when any large purpose was in view the sole objective should be its accomplishment, and there should be no jealousy or selfishness in the means used to attain the objective. We have never wanted to stand alone in any effort if other agencies could help, nor did it matter whether we or someone also originated the idea. Our part would be played as vigorously in the one case as in the other. We have, therefore, co-operated with all agencies which have worked in a forward-looking attitude for the advancement of the engineering profession and industry; we have co-operated with the engineering societies, national and local, with trade and industrial associations of every kind; with government agencies; with research bureaus.

"Finally, we have had the faith that sincere and needful service would be repaid with ample means for rendering the service. We have believed that if we gave we should eventually receive, and have not been disappointed.

"I rejoice in the engineers and industrialists with whom I have worked, and of whom you are representative tonight. I recall with pleasure the movements that we have jointly fostered. I survey with wonderment the astonishing progress that you, my own friends, have wrought in electricity, in urban transportation, in mechanical, civil and mining and chemical engineering. You, my friends, have remade the physical conditions of the civilized world in these forty years. Whatever my own shortcomings, I have a right to be inordinately proud of my friends—of you and your accomplishments. You have been, in very truth, the creators and builders of our modern material civilization.

Honored on 66th Birthday



James H. McGraw

Road Builders Announce Annual Program

Twenty-fourth Convention to Follow Two-Session Plan—Exhibits at Road Show Extensive

The twenty-fourth annual convention of the American Road Builders' Association will be held in Chicago, Jan. 11-14. Combined with the technical part of the program will be the road show, which promises to break all records in the number and extent of exhibits.

The first day of the convention has been set aside as Governor's day, the second as Pan-American Day and the third as States' Day. Because of the popularity last year of the double sessions, this plan will again be followed.

On Jan. 11 the opening address will be made by Henry G. Shirley, president of the association. His will be followed by addresses by Governor Len Small, of Illinois, Mayor William E. Dever, of Chicago, and Thomas H. MacDonald, chief of the Bureau of Public Roads.

At the afternoon session on Jan. 11 the engineers' sessions will be presided over by George F. Schlesinger, director of the Ohio Department of Highways and Public Works, and the general subject will be on work preliminary to construction. The principal speakers at this session will be Ben H. Petty, assistant professor of highway engineering at Purdue University; H. E. Breed, consulting engineer, New York City; Col. Woolsey Finnel, probate judge, Tuscaloosa, Ala.; and T. Warren Allen, chief of the division of control of the Bureau of Public Roads. The contractors' section will consider the general subject of contracting as a business. The meeting, presided over by Allan J. Parrish, will have as principal speakers J. H. Ellison, president of the Associated General Contractors of America; H. A. Wheeler, vice-president, Union Trust Co., Chicago; George Drake, Minneapolis contractor, and E. A. St. John, president of the National Surety Co. The program for the remaining sessions follows:

WEDNESDAY MORNING, Jan. 12, 1927

GENERAL SESSION: PAN-AMERICAN DAY

Presiding—Diaz Leal, Mexico.

Presiding—R. Keith Compton, director Department of Public Works, Richmond, Virginia.

Canada's Highway Problem
E. A. James, chief engineer, Toronto and York Roads Commission, Toronto, Canada.

The Highway Situation in Mexico
Andres Ortis, Department of Communication, Mexico, D. F.

Chilean Policy of Road Construction, Maintenance, and Finance—Benjamin Gonzales Cohen, secretary to the Chilean Embassy and formerly of the Public Works Division of the Government of Chile, Santiago.

Road Construction in Cuba
Manuel Alberto Coroalle, construction engineer for the Cuban Department of Public Works, Havana, Cuba.

WEDNESDAY AFTERNOON,

ENGINEERS' PROBLEMS

Presiding—Cyrus S. Avery, chairman, Oklahoma Department of Highways.

General Subject—Construction

Latest Improvements in Construction Methods — B. H. Piepmeier, chief engineer, Missouri State Highway Commission.

Contract Control and Engineering Service—Leslie R. Ames, acting state highway engineer, North Carolina State Highway Commission.

Control of Materials and Results
H. S. Mattimore, engineer of tests and materials investigation, Pennsylvania Department of Highways.

Best Method of Control and Payment for Pavement Quantities — F. E. Kelly, acting chief, Division of Tests, Bureau of Public Roads.

CONSTRUCTORS' PROBLEMS

Presiding—Edward McGrady, president, Associated Pennsylvania Constructors, Harrisburg, Pennsylvania.

General Subject—Practical Operating Methods

Estimating and Cost Accounting for Highway Construction—R. C. Jacobs, president, Juniata Paving Co., Philadelphia, Pennsylvania.

Value of Engineering Representation in Contracting Organizations — W. M. Wilmore, vice-president, Wabash Construction Co., Vincennes, Ind.

State Versus Contractor's Control of Material

Do Contractors Charge Equipment Rental Sufficient to Pay the Interest on the Investment, Operating and Replacement?—C. A. Eichelberger, equipment engineer, Pennsylvania Department of Highways, Harrisburg, Pennsylvania.

THURSDAY MORNING, Jan. 13, 1927

ENGINEERS' PROBLEMS

Presiding — Thos. J. Wasser, Jersey City, N. J.

General Subject—Operation and Maintenance

Selection, Use, and Care of Equipment —W. H. Root, maintenance engineer, Iowa Highway Commission.

Maintenance Ills, Their Diagnosis and Cure — William H. Connell, acting secretary of highways and engineering executive, Pennsylvania Department of Highways.

Subgrade Effects Upon Highway Maintenance—Prof. Frank H. Eno, Ohio State University, Columbus, Ohio.

CONSTRUCTORS' PROBLEMS

Presiding—W. J. Wilkinson, president, Northern California Chapter, Associated General Contractors.

General Subject—Enlargement of Contractors' Field

Is the Contractor's Loss a Public Gain? —Robert B. Brooks, director, Streets and Sewers, St. Louis, Mo.

Economic Waste in Construction of Public Work by Day Labor—General R. C. Marshall, general manager, Associated General Contractors, Washington, D. C.

Benefits of Highway Contractors Associations to the Contractor, Political Subdivisions and the General Public —William F. Lodge, contractor, former president, Illinois Association Highway and Municipal Contractors, Monticello, Ill.

THURSDAY AFTERNOON,

FINAL GENERAL SESSION

Presiding — Dr. Fons A. Hathaway, chairman Florida State Highway Department.

General Subject—Highway Problems

Best Method of Control and Payment for Pavement Quantities—J. E. Ellison, first assistant commissioner and chief engineer, Minnesota State Highway Department.

Should Engineers' Estimates Be Made Public?—Arthur W. Brandt, commissioner of highways, State of New York.

Practical Qualifying of Bidders on Public Works—Frank T. Sheets, chief highway engineer, Division of Highways, State of Illinois.

Increasing Efficiency in Highway Construction Organizations—J. L. Harrison, highway engineer, U. S. Bureau of Public Roads.

Building Trades Employers Meet in Pittsburgh

Resolutions Adopted Against Further Wage Increases and Proposed Five-Day Week

More than 135 of the leading building trades employers of the country met during the last week at Pittsburgh at a conference called by the National Association of Building Trades Employers and unanimously voted to stand against both further wage increases and the establishment of the five-day week in the building industry. The consensus of opinion was that the public was tiring of increasing labor costs and that a slump in construction activities threatened unless labor takes a more sane and reasonable attitude on wages. It was pointed out that the training of more apprentices would go far toward solving the labor problem.

The important points in the three resolutions adopted are:

1. "We protest against and will resist by every lawful means the adoption of the five-day week in the building industry." The economic reasons upon which this decision was based included (a) the already seasonal character of the building industry, (b) increased cost of building because of additional overtime necessary, (c) reduction of available labor in proportion as the hours were reduced, (d) the already distinct trend toward extravagance induced by idle time.

2. "A careful analysis fails to reveal any economic reason for any advance in the already high wage rates paid in the building trades.

3. "There is a necessity for the induction into the building industry each year of a greater number of skilled mechanics."

Queens Borough Starts Operating 80 M.G.D. Screening Plant

Designed to serve 24,000 acres, or approximately one-third of the area of the borough of Queens, the new screening plant officially opened on Dec. 15 at Jamaica, L. I., is claimed to be the largest of its kind yet constructed. It has a screening capacity on two 26-ft. diameter Riensch-Wurl screens of 80 m.g.d. and is designed to care for the sanitary sewage of a section of New York City which has doubled in population in the past two years. The cost of the plant was $1,656,949.

The pumping machinery and screens are located in a circular concrete caisson 82 ft. in diameter sunk in water bearing sand to El. —54 and on top of which the building housing the control of machinery is located. The construction of the caisson was described in *Engineering News-Record*, June 24, 1926, p. 1016. Grit chambers are provided outside of the main building from which the sewage flows on to the 26-ft. screens furnished by the Sanitation Corporation.

The pumping plant which has a total capacity of 121 m.g.d., consists of four mixed-flow centrifugal pumps, of which three are 30- and one 24-in. The screenings are pneumatically conveyed to a hopper storage building from which they are trucked and buried.

This screening plant is the first of a series of three similar units that are planned at the same location. The sewage system of this section of the borough of Queens is entirely a new project, including all of the intercepting and main sewers. The screening plant was built by the Awixa Corp. under the supervision of the Queens Department of Sewers, James Rice, engineer-in-charge.

F. M. Feiker to Direct Business Papers

Frederick M. Feiker has been appointed managing director of The Associated Business Papers, Inc., which has announced the inauguration of a more active policy and a broader program in the promotion and development of higher standards of journalism for the business press.

Mr. Feiker was born in Northampton, Mass., in 1881 and was graduated as an electrical engineer from Worcester Polytechnic Institute in 1904. He was first associated with the General Electric Company, and later joined the A. W. Shaw Company where he established the magazine *Factory* and later was made chairman of the editorial board of *System* and *Factory*. In 1915 he went with the McGraw Publishing Co. as editor of the *Electrical World* and guided the early development of *Electrical Merchandising*, becoming eventually vice-president and editorial director of the McGraw-Hill Company. From 1921 to 1923 he was in Washington as Assistant to Secretary of Commerce Hoover, and on his return to New York became operating vice-president of the Society for Electrical Development, which he now leaves.

Engineering Societies

Calendar

Annual Meetings

AMERICAN ROAD BUILDERS ASSOCIATION, New York City; Annual Convention and Road Show, Chicago, Ill., Jan. 10-14, 1927.

AMERICAN ENGINEERING COUNCIL, Washington, D. C.; Annual Meeting, Washington, D. C., Jan. 12-15, 1927.

SOCIETY OF AMERICAN MILITARY ENGINEERS, Washington, D. C.; Annual Meeting, Washington, D. C., Jan. 17, 1927

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual Meeting, New York City, Jan. 19-21, 1927.

ASSOCIATED GENERAL CONTRACTORS, Washington, D. C.; Annual Convention, Asheville, N. C., Jan. 24-28, 1927.

ENGINEERING INSTITUTE OF CANADA, Montreal; Annual Meeting, Quebec, Feb. 15-17, 1927.

AMERICAN CONCRETE INSTITUTE, Detroit, Mich.; Annual Meeting, Chicago, Ill., Feb. 22-24, 1927.

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago, Ill.; Annual Convention, Chicago, Ill., March 8-10, 1927.

NATIONAL FIRE PROTECTION ASSOCIATION, Boston, Mass.; Annual Meeting, Chicago, Ill., May 9-12, 1927.

The Engineers Club of St. Louis at its meeting Dec. 8, which was arranged in conjunction with the local section of the American Institute of Mining and Metallurgical Engineers, had a paper on mechanical loaders in metal mines, by W. H. Comins, National Lead Co., and another on mechanical loaders in coal mines, by W. F. Davis, Southern Coal, Coke & Mining Co.

The Dayton, Ohio, Section of the American Society of Civil Engineers at its annual meeting Dec. 13 elected the following officers for the coming year: F. J. Cellarius, president; N. Q. Sloan and C. H. Eiffert, vice-presidents; and C. S. Bennett, secretary-treasurer.

Personal Notes

T. H. CUTLER, of Jefferson City, Mo., has been appointed chief engineer of the Missouri State Highway Department, succeeding B. H. PIEPMEIER, who has resigned. Mr. Cutler has been in the department since 1923, beginning as an assistant division engineer. Preceding and following a period of service overseas during the War, he was engaged in contracting in municipal drainage and highway work, and for a time was manager of his own company, the Thos. H. Cutler Co., engineers and contractors.

B. H. PIEPMEIER, since 1922 chief engineer of the Missouri State Highway Department, has resigned to accept a position in private engineering and contracting with Theodore Gary, a former member of the Missouri State Highway Commission. Mr. Piepmeier has been engaged in municipal and highway work for twenty years. In 1907 he was assistant city engineer of Columbia, Mo. From that time until 1922 he served with the Illinois State Department of Highways, as assistant engineer, district engineer, maintenance engineer, and then in charge of all construction work.

FRANK C. HUFFMAN, assistant engineer of maintenance, Chicago & Northwestern Ry., has been appointed assistant chief engineer, succeeding D. ROUNSEVILLE, retired. FRANK W. HILLMAN, division engineer, takes Mr. Huffman's place.

EDWARD E. STETSON, engineer of construction of the Chicago Union Station Co., has been appointed assistant to the chief engineer of the Pennsylvania R.R., with office at Chicago.

ARTHUR N. DOUD, a hydraulic engineer of Cleveland, has been engaged by the borough of Woodlawn, Pa., to investigate and report upon existing flood conditions and recommend such construction as is deemed necessary.

CHARLES P. WILLIAMS, recently of Denver, Colo., announces that he has opened an office as consulting engineer at 903 Central Building, Los Angeles, Calif. Mr. Williams was formerly assistant chief engineer for the U. S. Reclamation Service, and has had twenty years of experience in the work of that bureau, including the study of water supply and storage possibilities and the design, construction, operation and maintenance of irrigation works, dams, pipe lines, canals and drainage works. He will do consulting work in investigation, design and supervision of construction of such works.

EDWIN A. FISHER, of Rochester, N. Y., in the employ of that city for 33 years in an engineering capacity, will retire Dec. 31 because of civil service regulations (he is 79 years of age), but will continue to be consulted by the city. He was city engineer of Rochester for eighteen years, resigning in 1913 but continuing as consultant. Later he became superintendent of city planning and aided in forming zoning regulations. In earlier years he was engaged in railway engineering, location, construction, operation and maintenance. His consulting practice has included bridge engineering; among other projects he designed the new north-end bridge in Springfield, Mass., in 1923, replacing one that had been destroyed by fire. He has also been consulted widely in municipal engineering by many cities in the United States.

A. H. WIETERS, director, division of sanitary engineering of the South Dakota State Board of Health, is appointed chief engineer of the Iowa State Department of Health, succeeding H. V. PEDERSEN, who resigned to take position as water-works superintendent at Marshalltown, Iowa. Mr. Wieters was formerly assistant engineer of the Kansas State Board of Health.

Construction Equipment and Materials

A SECTION DEVOTED TO WHAT THE MANUFACTURER IS DOING FOR THE ENGINEER AND CONTRACTOR

Care of Construction Machinery During the Winter

The Harnischfeger Corp., Milwaukee, offers the following information as to the proper method of taking care of a gasoline power shovel or crane before it is stored for the winter. Practically the same procedure is applicable for any general overhauling of the equipment at all times. "The first thing to do before starting the actual work of overhauling is to ascertain as far as possible what replacements have to be ordered from the factory so that these will be on hand when needed." The most vital points to be considered in overhauling are listed below:

For the Gas Engine

1. Have engine inspected by competent mechanic.
2. Remove carbon and grind valves; inspect crankshaft and connecting rod bearings, scraping the latter to a perfect fit or replacing if badly worn.
3. Clean carburetor and see if needle valve is worn.
4. Clean the radiator and cylinder jacket.
5. Replace all oil-soaked wiring and inspect magneto points.
6. Wash crankcase with gasoline and fill with fresh oil.
7. Drain and clean gasoline tank.
8. Grease all finished parts. Be sure no water has been left in the radiator and pump.

The Machine Itself—

1. Remove grease and dirt.
2. Inspect bearings and bushings, rebabbitting when needed.
3. Tighten all bolts.
4. Inspect clutches and brakes and replace if worn.
5. Inspect corduroys and replace worn roller bushings, link pins, or link pin bushings.
6. Inspect cables, clean and slush with oil.
7. Cover all finished parts with heavy grease.
8. Clean all rusted members with wire brushes and give a coat of good paint.
9. Either run machine in a shed or otherwise board it up with cheap lumber and heavy tar paper.

With all painted parts properly brushed and repainted with a heavy coat of good paint, and all finished parts liberally slushed with heavy grease, outdoor storage during the winter will not do a great amount of damage.

Spring Date for Leipzig Trade Fair Announced

The Leipzig Trade Fair, representing every phase of the industrial life of Germany, will be held from March 6 to 12, 1927. The official announcements show that there will be included some 2,300 exhibits of machinery, 1,500 exhibits of textile goods, and a similar number of metal wares. More than a score of countries will send exhibits. An opportunity is thus presented for American manufacturers and buyers to establish foreign contacts. Detailed information concerning the exhibits may be obtained from the Leipzig Trade Fair, Inc., 630 Fifth Ave., New York City.

P.R.R. Orders Equipment for Main Line Electric Operation

The Pennsylvania R.R. has announced that electrical equipment for a total of 128 passenger cars has been ordered in preparation for electric operation of the southern division main line between Philadelphia and Wilmington, Del., and the Octoraro branch between Philadelphia and West Chester, Pa. Extensive progress is being made on the work of electrifying these lines and the new equipment for them is expected to be delivered by November, 1927.

The orders for this equipment have been placed as follows: Westinghouse Electric & Manufacturing Co., apparatus for 93 cars; General Electric Co., apparatus for 30 cars; Brown-Boveri Electric Corporation, apparatus for five cars.

The Pennsylvania R.R. has also contracted for the electric equipment to be used in the construction of eight new locomotives to be operated in the New York tunnel service between Pennsylvania Station, New York City, and Manhattan Transfer. Four units each of this equipment have been ordered from the Westinghouse Electric & Manufacturing Co. and the General Electric Co.

The cars for the Philadelphia-Wilmington and Philadelphia-West Chester service will all be of the "multiple-unit" type, each car carrying its own motors.

The electrification work between Philadelphia and Wilmington and Philadelphia and West Chester involves approximately 52 miles of line and 150 miles of track. Its construction will give the Pennsylvania R.R. 90 miles of line and 264 miles of track electrified for suburban service, directly in and out of Philadelphia.

Business Notes

R. A. MANWARING has resigned from Dwight P. Robinson & Co. to become secretary and treasurer of the Philadelphia Electrical & Mfg. Co., Mr. Manwaring will succed C. L. Bundy, who has held this position since 1906.

MUNDY SALES CORP. announces that the George B. Curd Equipment Co., Cincinnati, Ohio, with James D. Hughes as sales manager, has been appointed its exclusive distributor in southern Ohio and eastern Kentucky for contractors' equipment only.

GRANT B. SHIPLEY, president, Century Wood Preserving Co., has been elected chairman, board of directors and chairman, executive committee of the American Nickel Corp., which specializes in the manufacture of pure nickel and alloy sheets, plates, bars, rods, wire and castings.

ALLIS-CHALMERS MFG. CO., Milwaukee, is opening a branch office at Jackson, Mich., with L. F. Berry as resident representative. Announcement is also made that Ernest Smith is the new sales engineer in the Oruro, Bolivia office, which is a branch of the company's district office at Santiago, Chile.

F. C. WILCOX, for 18 years president Foote Concrete Machinery Co., Chicago, Ill., has joined the Chain Belt organization in the capacity of eastern manager of paver sales. Mr. Wilcox will have headquarters in New York City.

THOMAS J. NEACY, president, Beaver Mfg. Co., Milwaukee, Wis., died Nov. 16, at the age of 78 years. He was in good health and his death was unexpected. P. C. Neacy, vice-president and general manager, has just been elected president. He states that no changes in personnel will be made.

New Developments

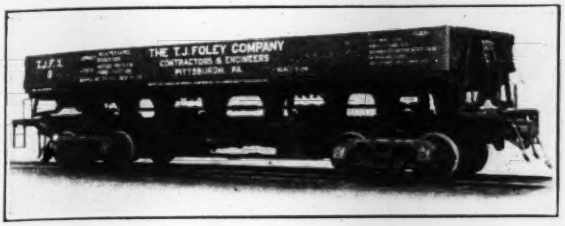
Construction Torches

A construction torch which will not tip over and will burn for approximately 48 hr. with one filling is manufactured by the McCloskey Torch Co., Toledo, Ohio, and is known as a bomb-shell torch. It is made of ⅛-in. rolled steel and has a 5½-lb. counter balance pressed in the bottom, which holds the torch in an upright position. It holds 3 qt. of oil and is furnished

with 18-in. asbestos wicking which, it is claimed, will never burn out. The torches burn fuel oil, and it is claimed they will remain lighted during the hardest wind and rain storms.

New Automatic Air Dump Car

Several contractors have within the past few months adopted a new type of railroad side-dump car manufactured by the Koppel Industrial Car & Equipment Co., Koppel, Pa. These cars are available in two types—drop-side type and lift-door type. On the drop-side type the material is discharged 4½ ft. from the rail. The cars dump either side of the track. They are equipped



with special three point hinges which are claimed to place the discharge edge of the car 7 or 8 in. further out than can be accomplished with ordinary single point hinges. The doors operate automatically in conjunction with the movement of the body by means of a mechanism located at the ends of the car. There are no door contrrol rods or operating members located under the body to become damaged or distorted. Dumping is accomplished by means of air cylinders equipped with hollow pistons placed at each side of the center sills. The entire dumping operation is automatic. The operation of dumping and returning to load position is done by the operator from a position on the ground at the end of the car or from the locomotive cab. A new locking mechanism of the compression type keeps the body in upright position after it has been returned to this position by air power. The lift-door type is of the same general design but, as the name implies, the sides lift up rather than turn down as the car is tilted.

Another Record-Breaking Turbine

The world's largest single-cylinder, single-flow steam turbine for driving an electric generator, rated at 63,000 kw., or 84,000 hp., is being built at the Schenectady plant of the General Electric Co. for the new Edgar generating station of the Edison Electric Illuminating Co. of Boston, located at Weymouth. This makes the third record-breaking generator now under construction. The other two are: a 208,000-kw. cross-compound turbine-generator to be installed in the new station of the State Line Generating Co. on the shore of Lake Michigan. This unit is the largest turbine generator of any type in the world. The other installation consists of two tandem-compound turbines, rated at 94,000 kw. at 90 per cent power factor, or 105,000 kw. at unity power factor, being built for the Southern California Edison Co. as noted in *Engineering News-Record*, Sept. 9, p. 440. These are the largest tandem-compound turbines ever built and will drive the largest generators, in physical size, ever built for any type of steam turbine.

Road Grader Uses Detachable Fordson Power Unit

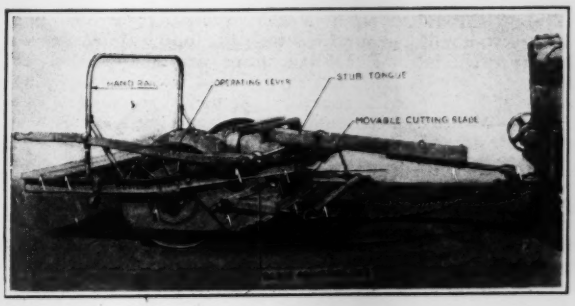
For those wishing to use the Fordson tractor for other purposes in addition to grading, the Wehr Co., Milwaukee, Wis., has developed a detachable grader, using the tractor as the power unit. The installation of the detachable grader to the Fordson tractor is said to require from 5 to 15 min.

One of the main features is that the grader wholly utilizes the tractor's weight, which, added to that of the grader, produces more pressure on the blade, making it possible to cut off the high hard spots on the road instead of riding over them. Conversely, the weight of the grader adds efficiency to the tractor, increasing its traction. In construction the detachable grader is similar to the company's standard model. Front cross braces tie the grader frames together and they are held together at the back by a cradle bracing which holds the grader rigid.

Wheeled Scraper Built Along New Lines

A new scraper recently placed on the market by the Western Wheeled Scraper Co., Aurora, Ill., is known as the "Tumblebug." It resembles in some particulars a wheeled Fresno, and was designed to meet a need for greater capacity in hauls which are too long for Fresno operation and too short for the use of a dump wagon. This scraper has a capacity of approximately 1 cu.yd. and weighs about 1,300 lb. It is said to be characterized by a very small number of parts and uses no gears or sprocket chains.

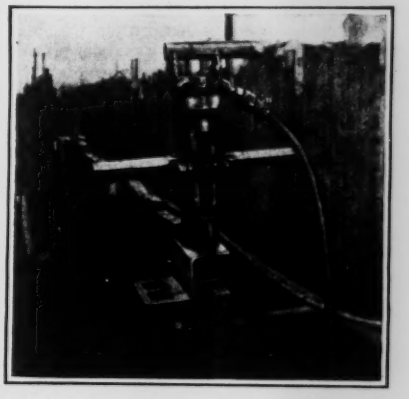
The cutting blade, which is separate from the pan, cuts to a point outside each wheel so that the wheels traveling back of the cutting edge always ride on a smooth surface. This is claimed to greatly lessen the strain on both the machine and the operator. All working parts are made of steel.



The operation of the pan is controlled by means of a lever within reach of the man who rides the machine. When the pan is in position for transporting the material, this lever is locked at the neutral point. In order to load the pan the man pushes the lever upward; in dumping, he pushes it downward, following which the pan makes a complete revolution, returning to an upright position.

Paving Breaker Altered for Piledriving

By means of a special front-head, together with foot-rests and an extra handle, the Ingersoll-Rand Co., New York City, has converted its standard CC-35 paving breaker into a piledriver to be used for light work. A very common application is its use for driving wooden sheeting in connection with sewer construction. It is claimed that the machine does not broom the pile since the blow is distributed over the



entire head of the pile. The foot-rests which enable the operator to stand on the machine while driving are easily removed if not required. Only one of them is shown attached in the illustration.

An Automatic Sump Pump

The new automatic sump pump manufactured by the Buffalo Steam Pump Co., Buffalo, N. Y., and used for draining pits, cellars and excavations, is said to offer five particular advantages: (1) It is easily installed being a self-contained unit which upon arrival needs only to be uncrated and connected to the electric current supply; (2) the motor shaft and pump are entirely inclosed and positively protected from action of sump water; (3) all parts are easily accessible; (4) ball-bearing thrust is used to carry the weight of the moving parts, which is adjustable to conditions of alignment; (5) oil in place of grease is used to lubricate the thrust, since it is claimed to be far superior for the intermittent use to which the bearings are subjected.

Where conditions require, duplicate outfits on a single cover plate can be furnished. The ordinary depth of pit used is 4 ft., covered with round or square plates 25 to 60 in. in diameter, with a manhole on the larger sizes if desired.

New Publications

Alloy Castings — SOUTHERN MANGANESE STEEL CO., St. Louis, Mo., has issued a catalog describing its alloy castings, which have been given the trade name of "Fahralloy." They were developed by Dr. F. A. Fahrenwald to meet varying heat resisting and corrosion resisting requirements. Information is given on the method of manufacture, on the thermal and general characteristics of the alloys, and illustrations are given showing some of the many types of castings available.

Concrete Mixers—KOEHRING CO., Milwaukee, Wis., has issued a new catalog No. 26 containing 48 pp. devoted to its heavy-duty mixers including the 10S, 14S, 21S and 28S sizes. A page with detailed illustrations is devoted to each important part of the mixer, such as the drum, the driving unit, the clutches, the axle, the main frame, the charging skip, etc. In the back, tabulated specifications for each size are given as well as drawings showing general dimensions.

Hoists—AMERICAN ENGINEERING CO., Philadelphia, Pa., has issued a 42-page catalog describing its "Lo-Hed" hoists operating on overhead trolleys. The new catalog includes six new hoists of larger capacity, extending the range of capacities offered up to 24,000 lb. It describes four classes of hoists, each class being built in from two to six sizes. The catalog contains specifications on all sizes and models, together with a large number of installation views and a list of representative installations.

Snow Removal — GOOD ROADS MACHINERY CO., INC., Kennet Square, Pa., has issued its annual Handbook on Snow Removal for 1927. Such items are considered as organizing for snow removal, procedure in snow removal for counties and cities and for different locations, such as sidewalks, drains, gutters and streets, drift prevention, private effort at snow removal, equipment for snow removal and a table giving comparative snow removal data compiled by the United States Bureau of Public Roads. This book should prove of value to anyone interested in the snow removal problem.

Chain Hoists and Trolleys—WRIGHT MFG. CO., Lisbon, Ohio, has just issued a new catalog No. 11 which is a comprehensive handbook on chain hoists, trolleys, hand cranes and similar equipment. It contains cuts, descriptive matter and line drawings giving all dimensions and clearance of the company's various products. It contains 71 pp.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

This Week's Contracts—Week Ago—Same Week Last Year

THE money value of contracts reported in the present issue of *Engineering News-Record* is here compared with the figures for corresponding weeks. Minimum costs observed are: $15,000 for water-works and excavations; $25,000 for other public works; $40,000 for industrial and $150,000 for commercial, educational, religious and other buildings. Under the head of excavations are included drainage, irrigation, levee, river and harbor projects.

Money Value of Contracts Let—Entire U. S.

Week Ending	Public Work	Private Work	Total Contracts
Dec. 23, 1926	$19,081,000	$14,930,000	$34,011,000
Dec. 16, 1926	16,559,000	36,596,000	53,155,000
Dec. 24, 1925	16,412,000	58,307,000	74,719,000
Heaviest Week			
1926, Mar. 11	13,029,000	73,613,000	86,642,000
1925, Sept. 3	16,215,000	69,424,000	85,639,000
January 1 to date			
1926	1,076,824,000	1,748,997,000	2,825,821,000
1925	1,027,540,000	1,518,167,000	2,545,707,000

Prices in U. S. and Canada Compared

Since 1922 Building Materials Throughout the Dominion Have Been Relatively Lower than Ours

MEASURING the degree of inflation in prices of building and construction materials in this country and Canada since 1913, it is found that the United States occupies the more unfavorable position of the two.

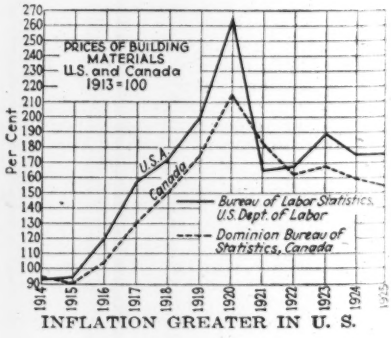
Taking 1913, the last pre-war year, as a base, Canadian prices during the following year, showed greater indications of inflation than did those in the U. S.

Beginning with 1915, prices in this country maintained higher elevations above the 1913 levels until the reactionary period of 1921 was reached. Inflation in the United States, during the peak year 1920, having been more pronounced than in Canada, the liquidation which occured the year following was necessarily more far reaching.

Since 1922 the Canadian prices have been relatively lower than ours, as shown by the accompanying illustration.

The index number of building and construction materials costs as computed by the Dominion Bureau of Statistics, comprises the following: white lead, ground, in barrels; putty, pure linseed oil, shellac, pure orange; linseed oil, raw; bricks, pressed No. 1; bricks plastic, common; cement, portland; lime, high calcium; cast-iron pipe, 4-in.; wire nails; steel rails, open hearth; spring hinges, No. 20; lead pipe; sash cord, No. 8; manila rope, best; metallic ceiling; steel sheeting, galv. No. 28, U. S. A.; glass, window, star; birch, C. & B.; fir, B. C. 2x4 in. and up, 6 to 16 ft.; hemlock, log run, 1-in.; oak, red; pine, good siding, 1x7 in. and up; pine, white, 1x12 in.; pine, No. 1 cuts and better; pine, box boards; spruce, 1x3 in., to 1x10-in. siding; spruce, 1x4 in. and up; lath, spruce; shingles, cedar, No. 1, Toronto; flooring, cedar; shingles, cedar, B. C.

Wholesale prices of building materials compiled by the Bureau of Labor Statistics, U. S. Dept. of Labor, comprise the following: brick, common, at kiln, Chicago; gravel, average for U. S.; hollow tile, Chicago; lime, common, lump, average for U. S. portland cement at plant; building sand, average for U. S.; bars, steel, reinforcing, Pittsburgh; nails, wire, Pittsburgh; structural steel, Pittsburgh; Douglas fir, No. 1, at mills; hemlock, No. 1 Northern Chicago; lath, yellow pine, at mills; red cedar shingles, at mills; oak, white, plain, Cincinnati; yellow pine flooring, at mills; plate glass, New York; window glass, f.o.b. works; linseed oil, New York; putty, New York; turpentine, New York; white lead, New York.



INFLATION GREATER IN U. S.

Materials Output and Demand Below Year Ago in Most Cases

Examination of production figures and unfilled orders at mills producing basic construction materials, reveals a fairly even adjustment of current output to demand in all sections of the country. This is particularly true of lumber and cement, while steel and brick offer slight exceptions to the rule.

Steel demand is following its normal seasonal course with prices extremely steady. Steel output, however, is not showing the upward tendency evident a year ago.

Brick supplies are accumulating at yards throughout the country, while orders show a seasonal decline. The situation in brick is, therefore, conducive to easier prices, while with steel the opposite condition evidently obtains.

Steel, lumber and brick show decreases in production and demand compared with this time last year, while cement registers substantial gains.

Since excessively heavy stocks of construction materials are not being maintained at either mills or yards in any section of the country and transportation facilities are becoming increasingly better, the present method of adjusting production to demand is working toward price stability.

This particular group of commodities, under present conditions, is exceptional in that the awarding of a construction contract practically constitutes the sale of materials before they are manufactured, thereby insuring a minimum of risk and price fluctuation.

OUTPUT AND DEMAND IN FOUR BASIC MATERIALS COMPARED WITH YEAR AGO

Material		Month Ended Nov. 30, 1926	Month Ended Nov. 30, 1925	Per Cent Gain (+) or Loss (—) Compared With Year Ago
Steel	Production	3,722,119 tons	3,902,900 tons	— 5.1
	Orders	3,807,447 tons	4,581,780 tons	—15.5
Cement	Production	14,193,000 bbl.	13,656,000 bbl.	+ 3.6
	Shipments	11,290,000 bbl.	10,187,000 bbl.	+10.8
Lumber	Production	865,644,964 ft.	894,823,159 ft.	— 3.2
	Orders	739,978,735 ft.	902,258,880 ft.	—18.0
		(Nov. 1, 1926)	(Nov. 1, 1925)	
Brick	Burned, on hand	286,952,000	306,588,000	— 6.5
	Orders	213,092,000	262,534,000	—18.7

Improvement Bond Issues, State and Municipal, Show Recovery from Recent Dullness

STATE and municipal bond sales in November were somewhat dull, the aggregate amount awarded being less than October this year and November last year. The total amount disposed of, according to the *Commercial and Financial Chronicle*, was only $63,559,902 as against $98,714,835 for October and $66,926,289 for November, 1925.

Since last month, however, the bond market has livened up considerably, the $20,000,000 bond offering of the Port of New York Authority having been readily absorbed by the investing public.

The five largest issues sold during November were as follows: $5,000,000 5's by the Los Angeles Flood Control District; $2,800,000 4½'s by Akron, O.; $2,400,000 5's by San Francisco; two issues of 5's aggregating $2,000,000 by the Los Angeles City School District; $1,985,000 4½'s by Newark, N. J.

The following table shows the aggregate disposals for November and the first eleven months since 1917:

	November	First 11 months
1926	$63,559,902	$1,171,476,991
1925	66,926,289	1,241,650,345
1924	74,765,203	1,305,270,172
1923	98,521,514	949,473,914
1922	44,379,484	1,034,567,913
1921	119,688,617	988,081,613
1920	57,602,117	627,711,624
1919	47,564,840	629,435,991
1918	27,783,332	273,572,370
1917	15,890,626	418,719,565

Some Representative Public Bond Sales, November, 1926

State	Purpose	Amount	Rate Per Cent	Sold for	Basis	Dated	Maturity	Purchased by
Alabama	Harbor Improvement	$1,000,000	4½	100.03	4.24	Dec. 1	1936–75	First National Bank of New York and others
Delaware	Highway	250,000	4	99.501	4.03	Jan. 1	1966	Farmers Bank of Dover
Louisiana	Improvement	500,000	4½	100.62	4.39	Nov. 1	1932	Wm. R. Compton Co. of St. Louis
Maine	Highway and Bridge	583,000	4	99.77	4.03	Dec. 1	1927–41	Shawmut Corp. of Boston
County								
Alameda, Calif.	Tube	500,000	5	105.12	....	.....	1936–38	Bank of Italy of San Francisco
Allen, O.	Improvement	15,846	5	101.32	4.73	Sept. 1	1927–36	W. L. Slayton & Co. of Toledo
Avenac, Mich.	Drainage	8,865	6	100	....	.....	1–10 yrs.	State Bank of Standish
Ashtabula, O.	Sewer	10,430	5	102.82	4.66	Nov. 15	1928–44	Taylor, Wilson & Co. of Cincinnati
Atlantic, N. J.	Road improvement	22,000	5	101.25	4.69	Oct. 1	1928–31	Stephans & Co. of New York
		20,000	5	101.28	4.60	Nov. 1		
Blackford, Ind.	Drainage	9,588	6	100.13	5.73	Oct. 1	1937–46	Fletcher American Co. of Indianapolis
Brunswick, N. C.	Road and bridge	160,000	6	107.34	5.32	Nov. 1	1931–52	Drake-Jones Co. of Minneapolis
Crawford, Ind.	Road	8,517	5	103.71	....	.....	1927–37	Fletcher American Co. of Indianapolis
Crawford, O.	Bridge	26,000	5	100.92	4.67	Aug. 1	1927–31	State Teacher's Retirement System
Elkhart, Ind.	Road	6,400	4½	101.28	4.26	Oct. 15	1928–37	J. F. Wild & Co. of Indianapolis
Fairfield, N. C.	Road	285,000	5	100.20	....	.....	.....	J. H. Hilaman & Co. of Atlanta and others
Greene, N. Y.	Highway	38,000	4.20	100.37	4.17	Oct. 1	1928–54	Pulleyn & Co. of New York and others
Harris, Tex.	Jail	600,000	4½	100.85	4.66	Apr. 10	1927–56	Taylor, Ewart & Co. of Chicago and others
Logan, Ky.	Road	125,000	4½	100.40	....	.....	.....	Caldwell & Co. of Nashville
Parke, Ind.	Drainage	2,779	6	102.34	5.50	Nov. 15	1927–36	Parke State Bank of Rockville
Princess Anne, Va.	Road	293,000	5	101.80	....	Jan. 1	1927–56	Brown, Bosworth & Co. of Toledo
Richland, O.	Road improvement	9,000	5½	100.88	5.04	Dec. 1	1927–29	Mansfield Savings Bk. & Tr. Co. of Mansfield
Sarasota, Fla.	Highway	680,000	6	96.25	7.00	May 1	1931–56	John J. George Co. of Cherryville
	Court house	50,000	6	100	....	Feb. 1	1956–57	
Starke, Ind.	Road	10,300	....	103.45	4.27	Sept. 15	1927–36	Meyer-Kiser Bank of Indianapolis
Sullivan, Ind.	Road	10,190	4½	101.48	4.20	Nov. 1	1927–36	Peoples Bank of Sullivan
Summit, O.	Road	57,650	5	.....	....	Oct. 1	1927–31	Detroit Trust Co. of Detroit
Trumball, O.	Hospital	150,000	4¼	101.91	4.24	Dec. 1	1927–43	W. H. Newbold's Sons & Co. of Philadelphia
Township								
East Wheatley, Pa.	Road	23,000	4½	100.86	4.65	Oct. 15	1927–46	C. Craig of Johnstown
Fairview, Pa.	Road	9,500	5	102.05	4.79	Nov. 1	1936–44	Prescott, Lyon & Co. of Pittsburgh
Jackson, O.	Road improvement	2,100	6	101.57	5.55	Nov. 1	1928–32	American First National Bank of Findlay
Municipal								
Aberdeen, N. C.	School	50,000	5	100.47	4.96	Oct. 1	1927–51	E. P. McMaken & Co. of Chicago
Albert Lea, Minn.	Sewer	90,000	4½	101.48	4.30	Oct. 1	1928–42	Paine, Webber & Co. of Minneapolis
Asbury Park, N. J.	Public improvement	349,000	4½	100.61	4.64	Nov. 15	1927–39	Geo. B. Gibbons & Co., Inc., of New York
Bay, O.	Street improvement	78,282	5	100.13	4.97	Oct. 1	1928–37	Otis & Co. of Cleveland
Beloit, Wis.	Sewer	25,000	4½	100.70	4.37	Nov. 1	1927–28	Beloit State Bank
Bolivar, N. Y.	Street improvement	13,000	5	101.60	4.66	July 1	1927–36	Sherwood & Merrifield, Inc., of New York
Bowling Green, Fla.	Street improvement	130,000	6	.....	....	June 1	1928–36	Farson, Son & Co. of New York
Clearwater, Fla.	Improvement	166,000	6	95.615	6.91	Oct. 1	1928–37	Stranahan, Harris & Oatis, Inc., of Toledo
Corpus Christi, Tex.	Street improvement	100,000	5	100	....	Sept. 1	1927–46	Sutherlin, Barry & Co. of New Orleans
	Waterworks	50,000						
	Sewer	50,000						
Darien, Conn.	High school	250,000	4½	101.659	4.25	Oct. 1	1966	R. L. Day & Co. of Boston
Depew, N. Y.	Sewer	20,000	4.6	100.03	4.59	Sept. 1	1927–36	Sherwood & Merrifield, Inc., of New York
Etowah, Tenn.	Street improvement	110,000	6	100	....	Sept. 1	1927–36	Caldwell & Co. of Nashville
Gardner, Mass.	Sewer	15,000	4	100.12	3.98	Oct. 1	1927–41	Merrill, Oldham & Co. of Boston
Hamilton, O.	Improvement	3,254	6	105.10	4.89	Oct. 1	1927–36	A. E. Aub & Co. of Cincinnati
Kenmore, O.	Waterworks	11,500	5½	102.13	4.59	Oct. 1	1927–31	A. E. Aub & Co. of Cincinnati
Mineral Hills, Mich.	Water	20,000	5	100.25	4.94	.....	1927–36	First National Bank of Iron River
Newark, N. J.	Water	1,985,000	4½	100.80	4.19	Nov. 15	1927–66	Roosevelt & Son of New York and others

Weekly Construction Market

STEADINESS marks the current building materials market both as to price and volume of demand.

Steel quotations have varied little since September. Lumber, after a slight spurt in the late Autumn, has dropped back to levels sufficiently low to discourage price concessions at mills.

Brick prices and those of construction materials other than lumber and steel, reflect the usual seasonal let-down. Wholesale prices of all commodities have been on the decline since September.

In the New York district especially, there is no change from last month's levels in most of the basic building materials. Practically the only exceptions are offered in the form of lower quotations for No. 1 Douglas fir two-by-fours and No. 1 common boards, and price advances in iron and steel pipe in up-state cities.

Linseed oil dropped 1½c. per 7½-lb. gal. at New York, during the week, following declines in Minneapolis, Dallas and Atlanta.

Steel prices hold at last week's levels in mills and warehouses throughout the country. Structural awards were exceptionally heavy last week. Demand is also active in car materials, track supplies, rails, sheets, bars, tin plates, steel plates and lap-weld pipe. Non-ferrous metals prices continue on the down-grade. This is significant when it is remembered that in consumption of copper alone, building is exceeded only by the electrical and automobile manufacturing industries.

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products									
Structural shapes, 100 lb.	$3.34	$3.80	$4.15	$3.10	$3.35	$3.87½	$3.30	3.15	$4.00
Structural rivets, 100 lb.	4.20	3.80	4.75	3.50	3.75	4.65	5.00	4.00	5.50
Reinforcing bars, ¾ in. up, 100 lb.	3.24	2.80	3.25	2.30@2.50	2.87½	3.77½	2.95	3.10	3.25
Steel pipe, black, 2½ to 6 in. lap, discount	48%	54%	54%	51%	54.25%	41%	49.7@54.1%	45%	37.83
Cast-iron pipe, 6 in. and over, ton	50.60	42.75	56.00	47.20	53.00	64.00	49.00	55.00	55.00
Concreting Material									
Cement without bags, bbl.	2.50@2.60	2.35	2.05	2.10	2.32	2.85	2.31	2.65	1.15
Gravel, ¾ in., cu.yd.	1.75	1.90	2.38	1.85	1.65	1.90	1.80	1.25	1.50
Sand, cu.yd.	1.00	1.60	2.00	1.65	1.25	1.00	1.40	1.25	1.25
Crushed stone, ¾ in., cu.yd.	1.94	2.50	2.83	1.87½	1.75	2.50	1.70	3.00	2.00
Miscellaneous									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	62.00	34.00	56.00	40.50	38.75	34.75	27.00	25.00	50.00
Lime, finishing, hydrated, ton	18.20	23.50	19.00	20.00	25.50	24.00	25.50	24.00	21.00
Lime, common, lump, per bbl.	2.10@3.00	1.50	+1.85	1.50	1.70	2.70	1.60	2.80	10.00
Common brick, delivered, 1,000	20.40@22.40	10.50	14.10	12.00	13.75	9@10	15.00	15.00	20.25
Hollow building tile, 4x12x12, per block	Not used	.0895	.11	.088	.076	.075	.....	.09	.10
Hollow partition tile 4x12x12, per block	.1027	.0895	.11	.088	.076	.075	.108	.09	.08
Linseed oil, raw, 5 bbl. lots, per 7½-lb. gal.	—.84¾	.90¾	+1.18	.84	.92¼	1.06	.98	1.12	1.05
Common Labor									
Common labor, union, hour	.90⅜	.30	.....	.90	.....	.50@.55	.55	.62½	.....
Common labor, non-union, hour	.....	.25	.40	.....	.45@.60	.40@.45	.50	.....	.30@.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent. L.c.l. is less than carload lots.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime in 280-lb. bbl. net and hydrated lime, f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Reinforcing bars (billet steel) and shapes delivered to job in less-than-carload lots.

Labor — Cement and concrete laborers' rate, $1.06½; building laborers, 90⅜c.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber, sand, gravel and stone f.o.b.; price on fir is quoted instead of pine. Reinforcing bars (billet steel) f.o.b. warehouse in carload lots; shapes, less-than-carload lots.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. Bars (billet steel) at warehouse in carload lots; shapes, less-than-carload lots.

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of Dec. 2 the next on Jan. 6.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered in wooden bbl. Common lump lime per 180-lb. net. Bars (billet steel) and shapes, l.c.l.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net. Bars (billet steel) f.o.b. in carload lots; shapes, l.c.l.

Dallas quotes lime per 180-lb. bbl. Cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered. Bars (billet steel) and shapes, l.c.l.

San Francisco quotes on Heath tile, size ½ x 8 x 11½. Prices are all f.o.b. warehouses except C.-I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common. Bars (billet steel) f.o.b. in carload lots; shapes, l.c.l.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Brick and hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers. Bars (billet steel) and shapes, less-than-carload lots.

Montreal quotes on fir lumber. Sand, stone, gravel and lump lime per ton. Stone and tile are delivered; sand, gravel, lime and cement on siding; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 99.90). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½ in., $37.83. Bars (billet steel) and shapes, less-than-carload lots.

Business Briefs

Call money quoted at 5½ per cent, Dec. 20; year ago, 6 per cent.

Time loans: 60 to 90 days, 4⅝; 4 to 6 months, 4⅝@4¾ per cent.

Commercial paper: Best names, 4@6 mo., 4½; others, 4¾ per cent.

On Dec. 1, 1926

E. N.-R. Construction Cost Index Number 210.80

E. N.-R. Construction Volume Index Number 211

For Explanation and Details of Indexes Since 1913 See the First Issue of Every Month